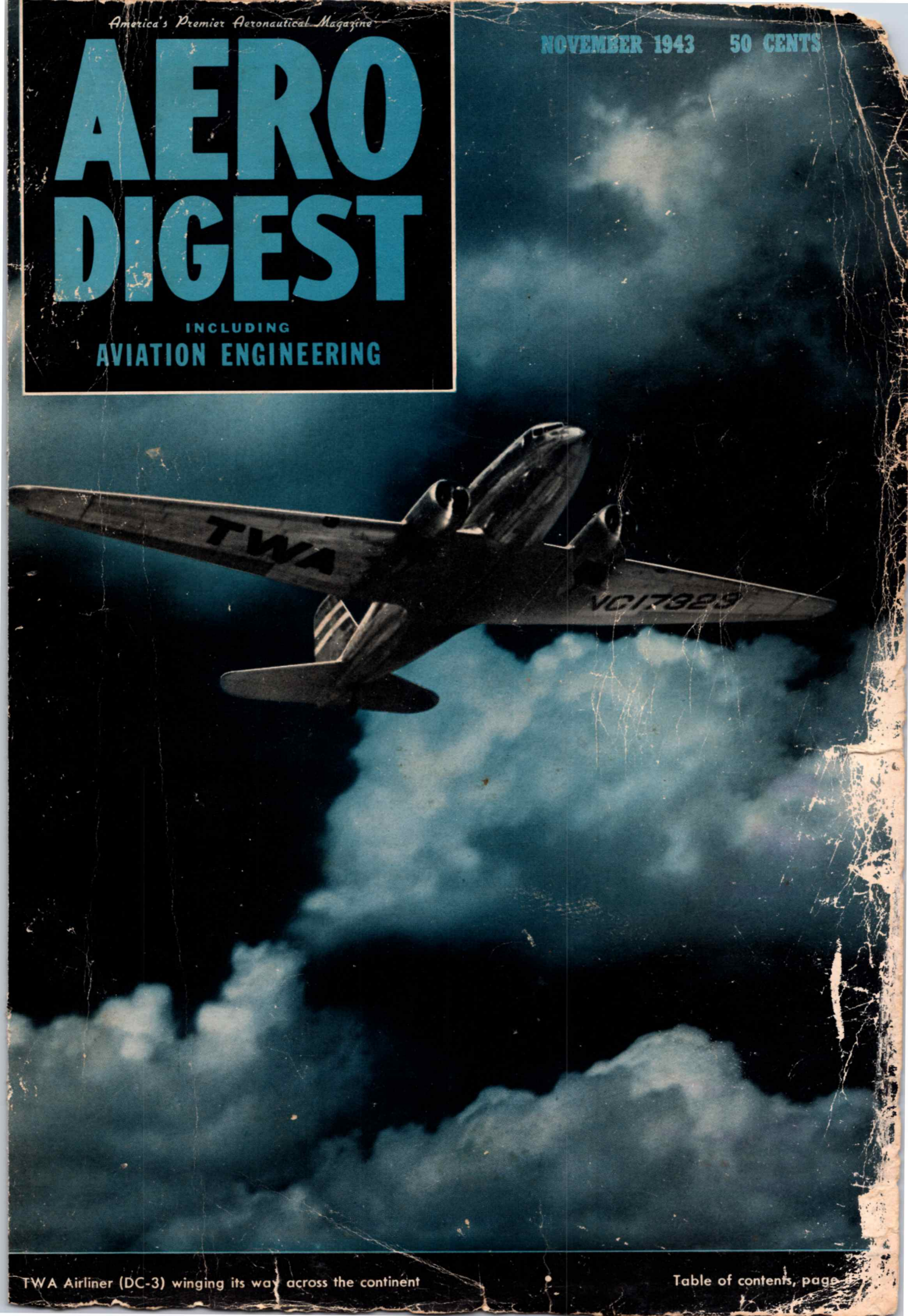
America's Premier Aeronautical Magazine

AERO DIGEST

INCLUDING

AVIATION ENGINEERING

NOVEMBER 1943 50 CENTS



TWA Airliner (DC-3) winging its way across the continent

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THE steel of this cam gleams like a mirror, as it gets its final buffing at the end of the production line. And it is not too fantastic that it should reflect the drama of battle in the skies. For those who work on Bendix-Scintilla* Aircraft Magnetos know well that this is a fight to the finish... even to the "finish" of a single steel surface.

America's mastery of the skies starts with superior engineering in every vital aircraft part... but it goes on from there to unsurpassed precision in every manufacturing detail. Especially in the Aircraft Magnetos that supply our warplanes with the very spark of life, creative engineering must go hand in hand with vigilance at every stage.

Bendix-Scintilla has accomplished many major developments in Aircraft Ignition... improvements that go far to make our Vehicles of Victory stand out already as the Transports of Tomorrow. But the firing line is still the final test... of magnetos, as of men. And Bendix-Scintilla will carry on, unrelentingly, its own special "fight to the finish."

BENDIX SCINTILLA

THE WORLD'S FINEST AIRCRAFT IGNITION

Bendix-Scintilla Aircraft Magnetos, Harnesses and Switches, vital members of "The Invisible Crew," are standard equipment for the major aircraft engine manufacturers, including:

Allison • Jacobs • Continental • Lycoming • Lawrance • Wright Aero Corp. • Pratt & Whitney • Warner • Packard • Ranger • Ford • Nash • Chrysler • Kinner.

SCINTILLA MAGNETO DIVISION

THE INVISIBLE CREW
Precision Equipment by
Bendix Aviation Corporation

*TRADE MARK OF BENDIX AVIATION CORPORATION

CURTISS-WRIGHT TECHNICAL INSTITUTE STUDENTS

Where Do They COME FROM!

om east to west and north to south in our own untry; from Alaska, Hawaii, Cuba, Puerto Rico, nada, China, India, Turkey, Central America, outh America and other friendly allied countries; mbitious young men come to CURTISS-WRIGHT ECHNICAL INSTITUTE.

These air-minded civilian students; college men, high school graduates, men from cities, men from farms, men from all walks of life; enroll at this most distinguished school of aeronautics for one purpose . . . . to prepare themselves for greater contribution to our war effort and at the same time for a lifetime career in after-the-war aviation.

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This enrollment from world-wide sources is significant. CURTISS-WRIGHT TECHNICAL INSTITUTE, one of the oldest and most progressive aeronautical schools, located in the heart of Southern California's giant aircraft industry, is recognized the world over as an institution offering the highest type of Specialized Aviation Mechanical and Aeronautical Engineering Training available.

Since the founding of this Institute in 1929 its object has been to prepare young men to advance in Aviation, to the highest position of responsibility and make money for them. Today, this training still being available to civilians, is doubly valuable because it not only prepares them for a lifetime career but for service in the Air Forces as well.

This specialized modern up-to-the-minute training has been proven by the success of thousands of CURTISS-WRIGHT TECHNICAL INSTITUTE graduates in all phases of aviation activity, both civil and military. All with exceptional value to the war effort.

The high standing of CURTISS-WRIGHT TECHNICAL INSTITUTE is indicated by Mr. Donald - las, President of the great Douglas Aircraft Con , in choosing this school for his own son's training. In addition, this school was selected to train Army Air Force mechanics by our government in 1939, long before the war.

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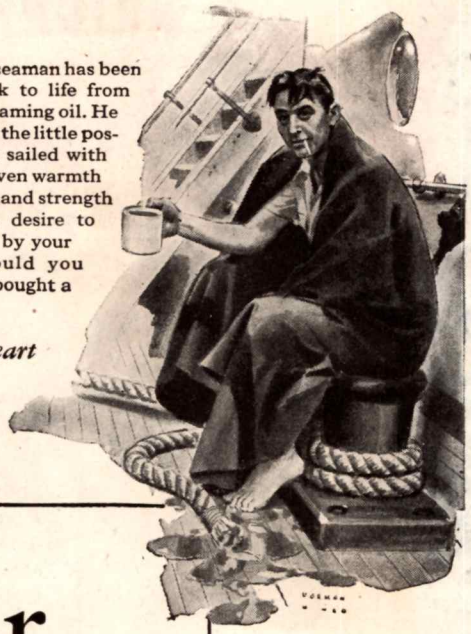
Index to advertisers appears on pages 524 and 526.

No, these are not Russian or Polish war orphans. They are right here at home. Their father, who was an automobile mechanic, is in Europe now, repairing American tanks. Their mother is in a war plant. Every night they sit here and wait her homecoming — and dinner. Your dollars can support playgrounds, equipment and care for them through one of your local welfare agencies. Would you rather have a new evening gown?

Let your heart decide



A merchant seaman has been dragged back to life from an ocean of flaming oil. He has lost all of the little possessions that sailed with him. He is given warmth and comforts and strength to fulfill his desire to "ship" again by your dollars. Would you rather have bought a new radio?

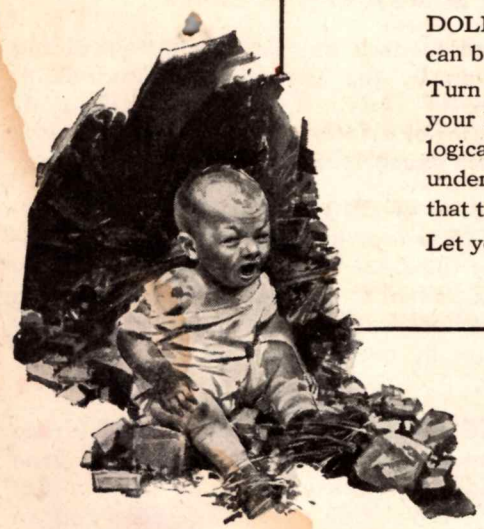
Let your heart decide

Let your heart decide

DOLLARS can be cold and selfish things. Or they can be generous, compassionate and merciful.

Turn over the spending of some of your dollars to your heart. It will want to give twice what your logical mind intended to give, because your heart understands the mercy, the relief and the pleasure that these dollars bring.

Let your heart decide.



This Chinese baby didn't have much, but yesterday it did have a straw shelter, a crude cradle and two parents to care for it. A screaming Japanese bomb destroyed them all. Your dollars can bring this baby back to a useful life in the new China to come. Would you rather have a new chair in the living room?

Let your heart decide

Remember this soldier? You saw him on the USO posters last year. His smile comes straight from a USO clubhouse. One of the finest things civilians have done in this war is in building and supporting the USO. Boys come into the army from farms and cities—a little lonely—a little homesick. The USO provides friendship, entertainment and hominess. Some of your dollars are spent through the USO. Would you rather have bought yourself a few theatre tickets?

Let your heart decide

Give ONCE for ALL these

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United Seamen's Service
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Belgian War Relief Society
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French Relief Fund
Friends of Luxembourg
Greek War Relief Association
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United Yugoslav Relief Fund
Refugee Relief Trustees
United States Committee for the Care of European Children

National War Fund

Give through your United Community Campaign

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VOLUME 43 NUMBER 5

A VITAL FORCE IN A VITAL INDUSTRY

AERO DIGEST

AVIATION ENGINEERING

AN A. B. C. PUBLICATION

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JOSE GARCIA DE SOUZA
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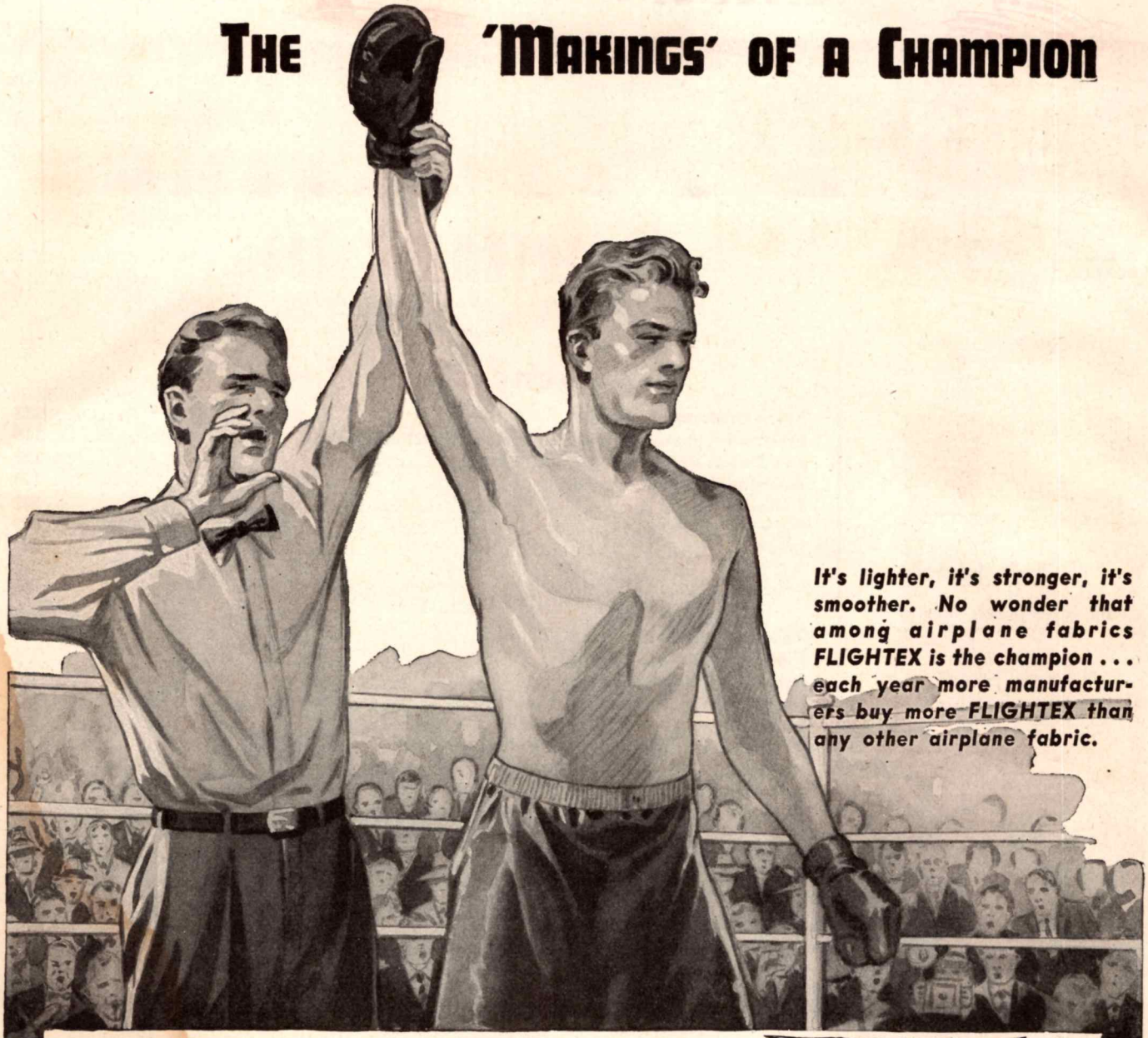
THE 'MAKINGS' OF A CHAMPION



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THE urgency of creating our great Allied air armadas required a production capacity many times that of America's aviation industry. So it invited thousands of manufacturers in many fields to "team up" in the vast program of making America *first* in the air.

Kollsman joined in this effort by "schooling" over a score of manufacturers in the difficult techniques of building complete Kollsman aircraft instruments.

Kollsman immediately threw open its facilities to the engineers of coöperating plants. Step by step, Kollsman engineers revealed to them in minute detail the intricate techniques of mass-producing these vital precision products. And then they frequently went into those plants and helped work out production . . . and kept at it until the last "bug" was ironed out.

It isn't easy to build instruments that meet Kollsman specifications. But our "team" is doing just that . . . and in ever-increasing volume. While this work goes forward, Kollsman is busy at the task of developing aircraft instruments to meet new flight problems.

THE KOLLSMAN 50,000 FT. SENSITIVE ALTIMETER *is so ingeniously geared that a diaphragm expansion of only three-sixteenths of an inch sends the pointer around the dial 50 times! Capable of measuring altitude to within a few feet, its essential parts are finished to within two ten-thousandths of an inch.*

KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

SQUARE D COMPANY

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA

NOW Class 9300 Circuit Breakers 5 to 125 Amperes

for use in Aircraft, Tanks, Boats, and other mobile equipment

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80-90-100-125 AMPERES
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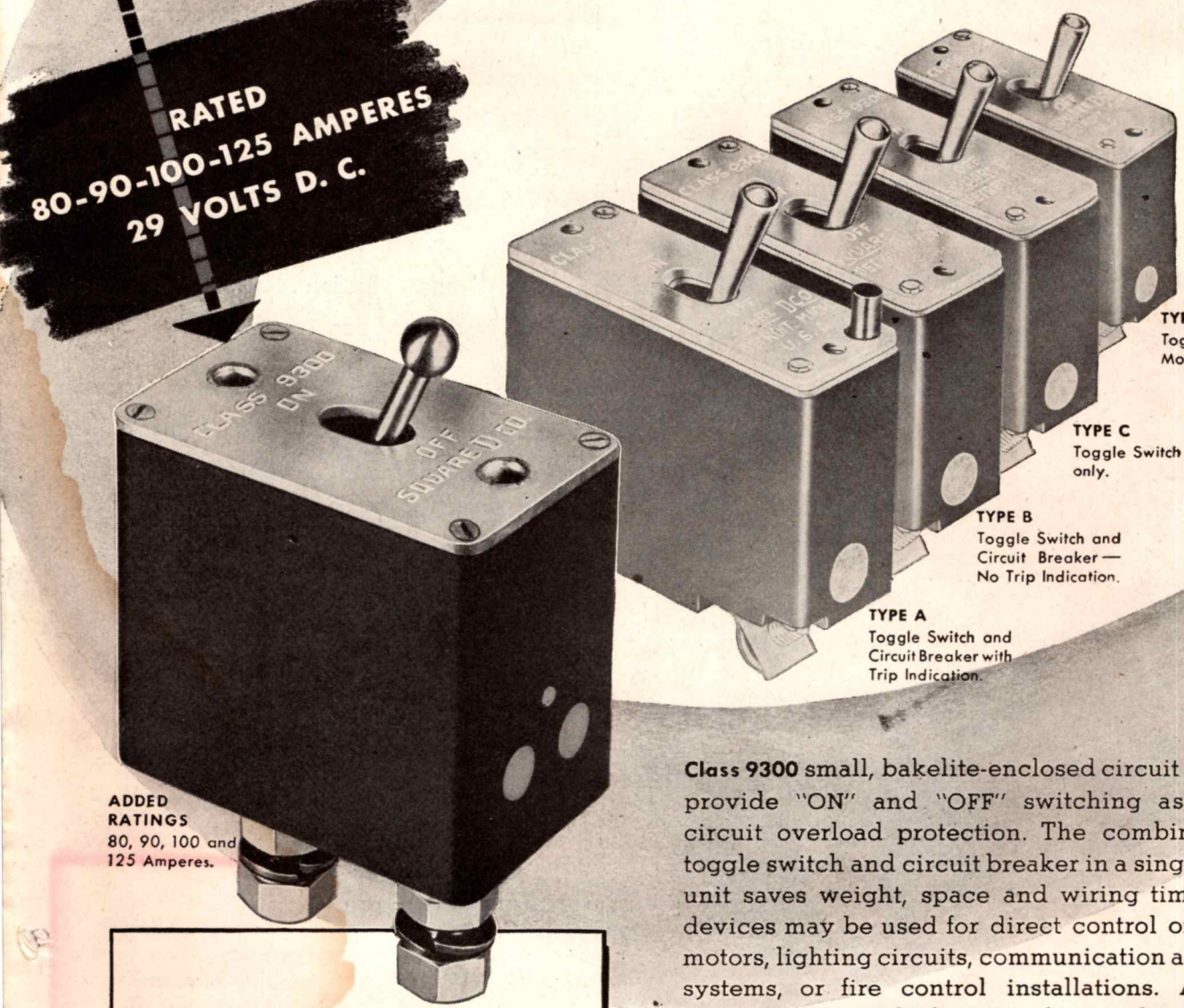

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Toggle Switch
Momentary "ON"

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Toggle Switch and
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No Trip Indication.

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Toggle Switch and
Circuit Breaker with
Trip Indication.

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ALL TYPES AND SIZES OF CLASS 9300 CIRCUIT BREAKERS HAVE THESE FEATURES

- ★ **Non-Trip Free.** Breakers may be held closed in an emergency.
- ★ **Acceleration Tested:** Acceleration force of 10 G's does not cause malfunctioning.
- ★ **Vibration Tested:** Breakers withstand up to 55 cycles per second at $1/32$" amplitude ($1/16$" total excursion).
- ★ **Ambient Temperature Range:** —60° F. to +135° F.

Class 9300 small, bakelite-enclosed circuit breakers provide "ON" and "OFF" switching as well as circuit overload protection. The combination of toggle switch and circuit breaker in a single sealed unit saves weight, space and wiring time. These devices may be used for direct control of electric motors, lighting circuits, communication and signal systems, or fire control installations. Although designed primarily for aircraft use, they are also suitable for boats, tanks, turrets and other mobile units having up to 29 volt D. C. power supplies.

Each breaker is calibrated and factory-sealed. There are no field adjustments—nothing to tamper with. After tripping, there is nothing to renew—merely move toggle lever to "ON" position.

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FOREST PATROL!

Every day the CAP Forest Patrol assists the U. S. Forest Service and the National Park Service . . . flying over America's vast forests, guarding them from sabotage, accident, negligence and the ravages of nature.

Piper Cub planes play no small part in this important Civil Air Patrol work. These dependable, maneuverable planes fly the valleys and spot blazes that cannot be seen by lookout towers until they become out of control. These blazes are reported while they are still one-man or two-man affairs.

Thus, while Piper Cub L-4 "Grasshopper" planes serve America on the battle fronts, other Piper Cub planes do vital work on the home front.

And, the wartime advantages of Piper planes will serve you in peacetime. Then you'll fly your smart, new Piper Cub on vacation and business trips with ease, pleasure, safety and economy.

FREE BOOKLET ON HOW TO FLY. Send today for your copy of "You, Too, Can Fly!" If you also want the full-color Piper catalog, enclose 10c in stamps or coin for postage-handling. Piper Aircraft Corporation, Dept. D113, Lock Haven, Penna.

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Points the Way to Wings for All Americans

Whatever the shape of Planes to come ✳

✳ WHAT ABOUT ENGINES FOR THESE NEW PLANES?

"YOU'VE been talking a lot in your advertising about post-war planes," says a letter from a well-known aircraft manufacturer, "but what kind of engines are you going to give us to power them?"

A fair question—and here, we hope, is a fair answer. It now appears that high octane fuels and new, lighter metals will be generally available at low cost after the war. Assuming this, *post-war Franklin engines will be lighter, more powerful, less expensive, and as dependable and economical in operation as ever.*

They will weigh less through greater use of aluminum, magnesium and plastics. Higher octane fuels will produce more power with the same displacement. In other words, Franklin engines for the planes to come will have a far more favorable power-weight ratio, developing more horse power per pound of engine weight. Greater production volume and finer manufacturing facilities should inevitably reduce the price of each engine.

All the war born knowledge gained by Aircooled Motors engineers during their years of designing and building new Army and Navy warcraft engines will be put to good use. With the return of peace it will mean finer Franklin engines for your private and commercial planes.

AIRCOOLED MOTORS CORPORATION
SYRACUSE, NEW YORK

Franklin
FINE AIRCRAFT ENGINES

ROCKBESTOS "KNOW-HOW" BUILDS PERMANENTLY INSULATED FIREWALL RADIO HOOKUP WIRE

REG. U. S. PAT. OFF.

For Airborne and Ground Equipment, and Instruments

Actual size of No. 18 AWG 1000 volt Rockbestos Firewall Radio Hookup Wire

Construction Detail—Enlarged 4 Times

First, a color-coded braid of glass yarn (or cotton or rayon) lacquer-finished to a hard, smooth surface that never becomes gummy or tacky and is resistant to heat, cold, moisture, oil, grease, gasoline and cleaning fluids.

Next, a firewall of resilient felted asbestos, impregnated with heat, flame and moisture resisting compounds, that acts as a heat-barrier against high ambient temperatures and won't burn under copper-melting arcs.

Then a thin, tough, mechanically strong synthetic tape for uniform high dielectric strength and high moisture resistance.

And finally, a stranded tinned copper conductor perfectly and permanently centered in helically applied insulation that will not migrate or flow under heat.

SHIELDED ROCKBESTOS FIREWALL RADIO HOOKUP WIRE

Made in the same construction as illustrated to the right, in single or multi-conductor, and covered with a tinned copper shielding braid. 1000 volt rating in sizes No. 18 to 4 AWG—3000 volt in sizes No. 12, 14 and 16 AWG.

★ ★ ★ ★ ★ ★

HOT OFF THE PRESS . . .

Rockbestos Firewall Radio Hookup Wire Bulletin No. 52-C Write for your copy, today!

It contains complete wire performance data, tests, braid patterns and specifications for ready reference on 1000 volt and 3000 volt Rockbestos Firewall Radio Hookup Wires. Ask for your copy . . . IT'S FREE!

Here's a wire that gives you heat and flame resistant characteristics, in addition to unusually high dielectric strength —Rockbestos Firewall Radio Hookup Wire—designed in 1937 to satisfy the requirements of aircraft radio manufacturers for a small diameter, light weight, stable, flame and moisture-resistant construction, and used since in a wide variety of radio equipment and electronic apparatus.

It is resistant to heat, cold, flame, oil, grease, gasoline, moisture, alkalies and corrosive fumes.

It is made in two constructions—1000 volt rated, in sizes No. 22 to 4 AWG and 3000 volt in No. 12, 14 and 16 AWG.

It has a wide operating temperature range—won't dry out in insulation-baking heat up to 125° C., or become brittle in sub-zero cold as low as minus 50° C.

The 1000 volt wire has been subjected to life voltage tests at rated voltage and 125° C. rated temperature for 2500 hours without failure—and at rated voltage and room temperature for 8000 hours.

The 3000 volt wire has been subjected to test at 5000 volts and 125° C. for periods in excess of 700 hours without failure—and at the same voltage at room temperature for periods in excess of 1200 hours.

Rockbestos Firewall Radio Hookup Wire was the first to successfully pass the Civil Aeronautics Authority's rigid anti-burning test for aircraft radio wire, and is now widely used in both airborne and ground communication systems, electrical apparatus and instruments requiring a light weight, small diameter, heat, flame and moisture resistant wire. Write for a bulletin and samples.

Rockbestos Products Corp., P. O. Drawer 1102, New Haven 4, Conn.

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ROCKBESTOS FIREWALL

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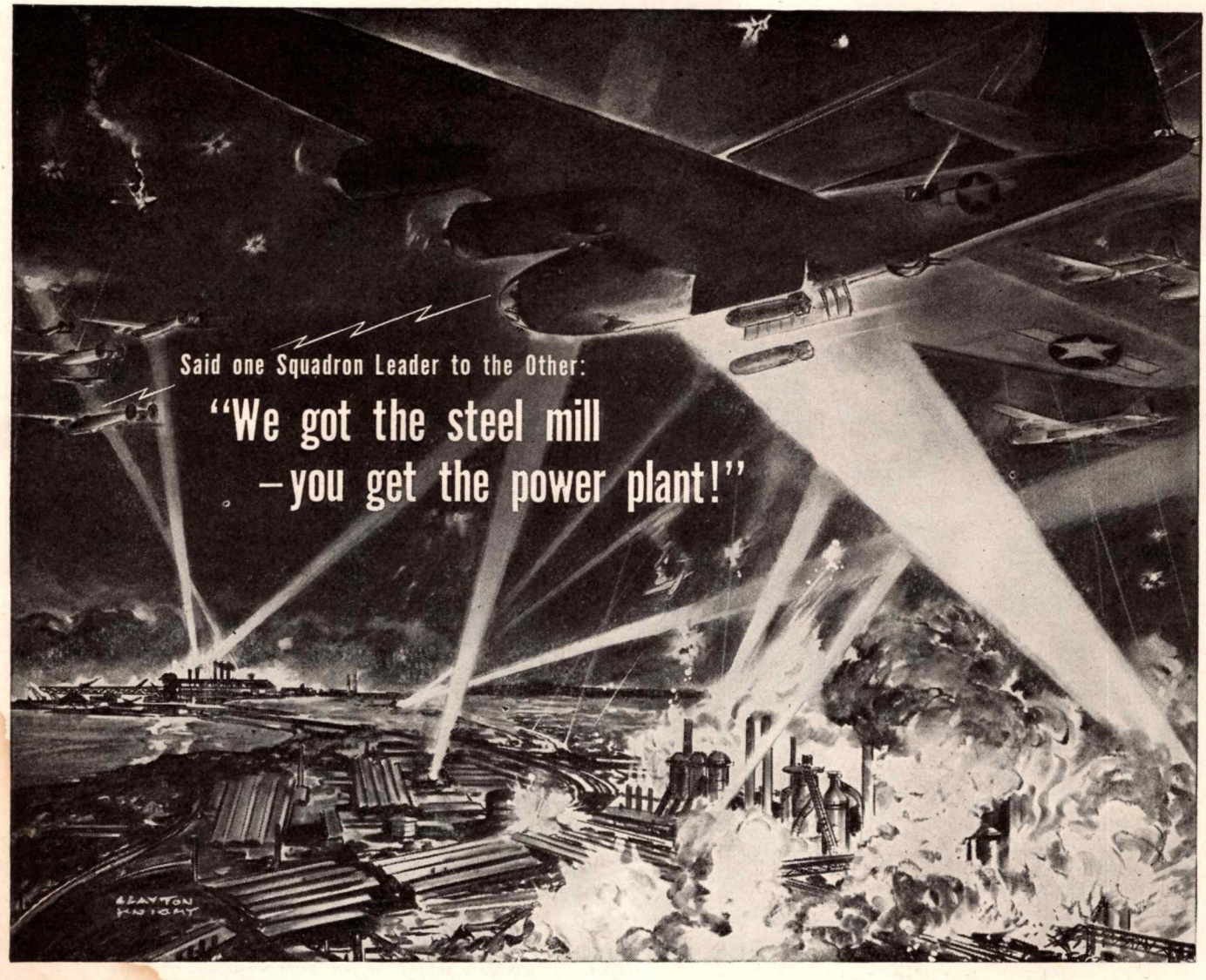
INVEST IN WAR BONDS • MAKE EVERY PAYDAY A LAY-AWAY DAY



The Attack Your Extra Bonds Must Back

Every penny counts — At FEDERAL, where communications equipment is made for our armed forces, an idea is spreading. For every axis plane reported shot down, employees drop an extra *coin in a box — for* extra *bonds for* extra *bombs and bombers.*

Thundering out of the overcast
Like a midnight express
The first wave of bombers
Spots the twinkling steel mill . . .
Blasts it into a roaring volcano
As the hinges of hell open
And fill the sky with daggers of light
And streaking, shrieking meteors of ack ack

Silhouetted against this inferno
Another target looms
And the young voice of the squadron leader
Speaking over the interplane radiotelephone
Calmly directs the *next* wave of bombers
To the doomed power plant ahead . . .

* * *

Shuddering under the impact
Of flak and fighter fire
The rocketing war birds
Level off into their "run"
And the pale bombardier catches his breath
Like he used to when he called signals
In the games back at "State"
As he whispers . . . *'Bombs . . . away!'*

Did he say *"bombs" . . . or "bonds"?*

* * *

Down they hurtle
The bonds
That have been converted into TNT . . .
Your milkman's bond
Your stenographer's bond
The bond of the woman who cleans your office
Of the neighbor whose boy was in today's battle
And YOUR *bond . . .*
Your EXTRA *bond . . .*
Is THAT *there, too?*

* * *

Here at I. T. & T.
And its associate companies
Communications equipment and services
Are only part of the job . . .
Every man and woman here
Is buying war bonds
Extra war bonds
To back the attack
And bring our sons and brothers
Home

I T&T

International Telephone and Telegraph Corporation *67 Broad St., New York 4, N. Y.*
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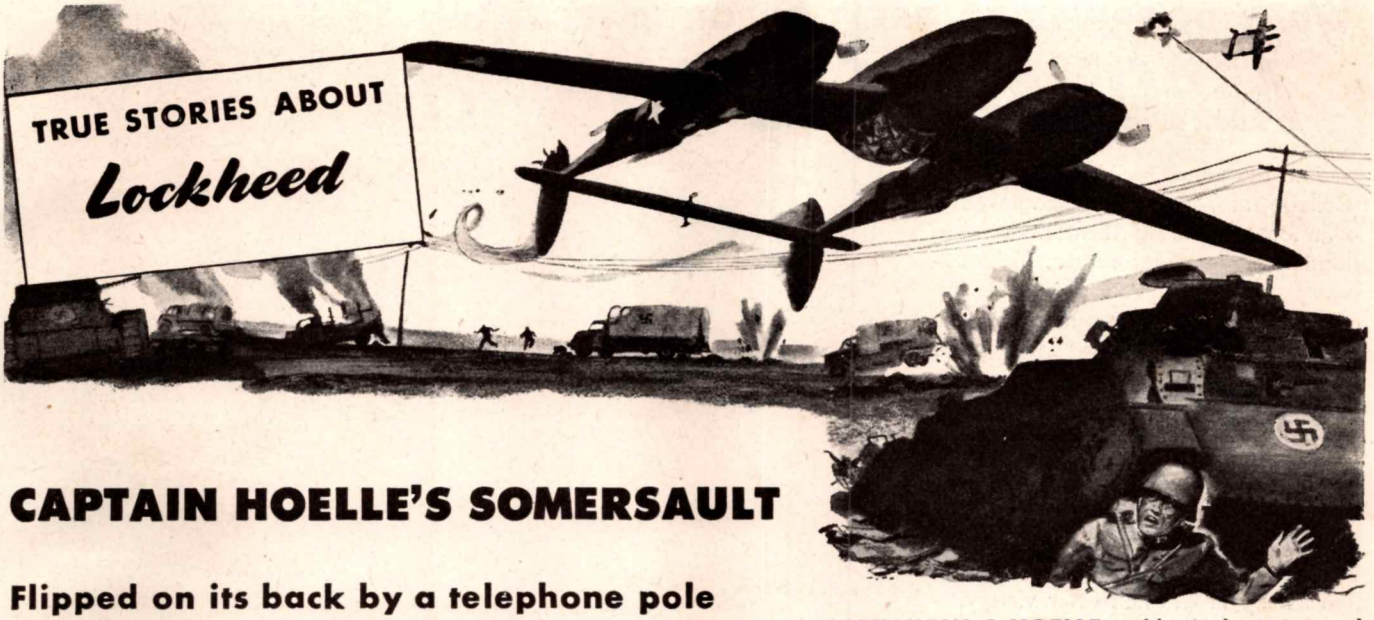
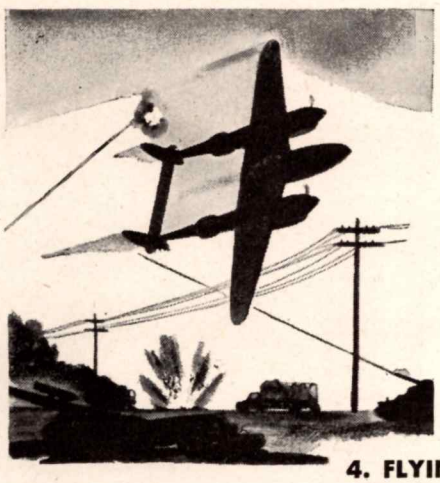


CAPTAIN HOELLE'S SOMERSAULT

Flipped on its back by a telephone pole a Lockheed Lightning flies home

Lightning P-38's were designed as interceptors—to climb to great heights, rapidly—to operate at peak efficiency above 15,000 ft. But action is where you find it in modern warfare, and this is the exciting, true experience of an American fighter pilot and his plane just twenty feet above the bullet-scarred earth of Tunisia.

1. CAPTAIN W. J. HOELLE and his Lightning squadron set out to break up Axis supply lines by ground-strafing trucks, tanks, troops and anything else that bore the German swastika. Up and down the Tunisian roadway they scattered men and equipment. Suddenly an enemy pillbox got its range—came too close for comfort. As Hoelle turned to blast the gun position, the tail of his plane hit a telephone pole. The plane was flipped onto its back just 20 feet above the ground.

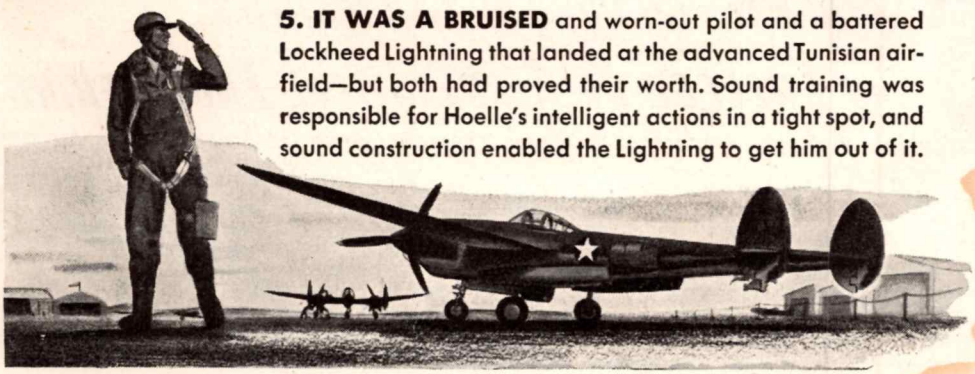


2. COOLLY, INSTINCTIVELY, Hoelle kicked full top rudder and full left aileron. The Lightning bounced crazily along through space, gradually working itself into a right bank position.

3. TOO LOW TO JUMP, too low to maneuver, impossible to land, it looked like "curtains" for Hoelle. Then he thought of lowering the wing flaps usually used for controlled landings. This gave the Lightning just the lift that was needed to pick up altitude and start home.

4. FLYING SPEED had been greatly reduced, and Hoelle's Lightning would have been easy bait for German fighters if his squadron mates had not formed a protective canopy over him for the 360-mile trip home.

5. IT WAS A BRUISED and worn-out pilot and a battered Lockheed Lightning that landed at the advanced Tunisian airfield—but both had proved their worth. Sound training was responsible for Hoelle's intelligent actions in a tight spot, and sound construction enabled the Lightning to get him out of it.



This is another in a series of stories about Lockheed and Vega and their accomplishments. Watch the pages of this magazine for another true aviation adventure.

LOOK TO

Lockheed

FOR LEADERSHIP

Lockheed Aircraft Corporation, Vega Aircraft Corporation, Burbank, Calif.

Your **DOORWAY TO GREAT OPPORTUNITY as an**

AERONAUTICAL ENGINEER

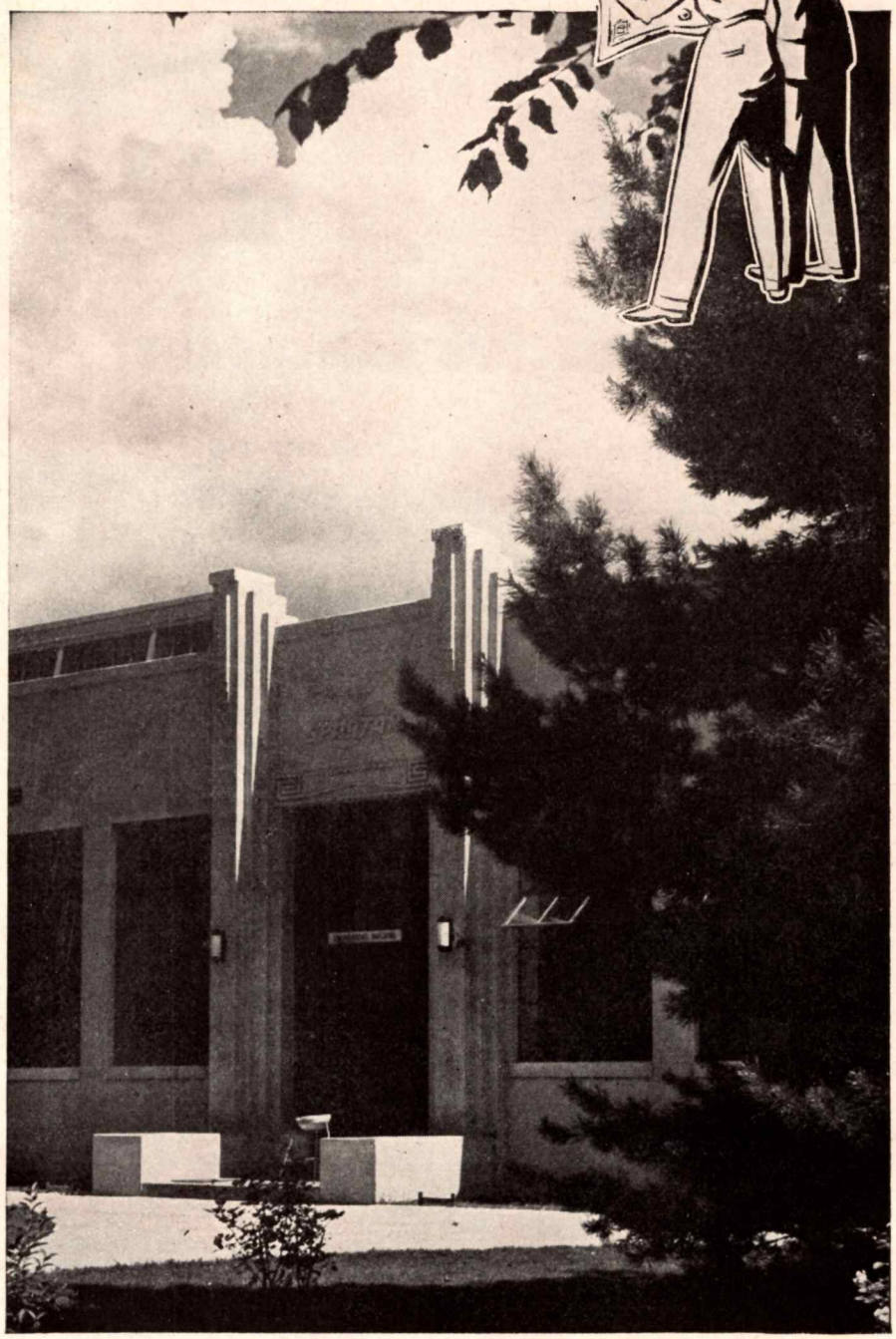
Join the young men at the Spartan College of Aeronautical Engineering who are preparing themselves for a lifetime professional career. Take advantage of Spartan's superior specialized training that can qualify you for higher grades and ratings when called to military service . . . that can prepare you for a prominent position in the great post-war aviation industry.

Aeronautical Engineers are urgently needed now! There will be a continued demand for such professional skill as America marches to world leadership in aviation after victory.

Thoroughly experienced and highly educated engineers who have had practical experience in the industry are ready to instruct you at Spartan. Shop courses are taught by instructors with U.S. Government certificates in their subjects. The Spartan Engineering Building is the most modern to be found ot any aviation school in the country. *In 20 months you can earn your degree of Associate in Arts in Aeronautical Engineering.*

The Spartan College of Aeronautical Engineering (Div. of the Spartan School of Aeronautics) is a private school member of the Oklahoma System of Higher Education and is recognized and accredited by the Oklahoma State Regents for Higher Education.

Whatever type of aviation career you choose Spartan offers you advantages obtainable at no other school of its kind. Select the course in which you are interested by checking the coupon below. ACT NOW! Next semesters start January third and March 27th.



* (Above) Entrance to the Spartan College of Aeronautical Engineering

SPARTAN SCHOOL OF AERONAUTICS
DIVISION OF SPARTAN AIRCRAFT COMPANY

and COLLEGE OF AERONAUTICAL ENGINEERING
DIVISION OF SPARTAN SCHOOL OF AERONAUTICS

SPARTAN SCHOOL OF AERONAUTICS
CAPT. MAXWELL W. BALFOUR, Director. Address Dept. AD113, Tulsa, Oklahoma

Send me your new Catalog, describing in detail the SPARTAN courses I have checked, also stating tuition and living expenses.

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CHECK COURSES YOU PREFER

- ☐ Aeronautical Engineering
- ☐ Airline Maintenance
- ☐ Commercial Pilot
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- ☐ Aircraft or Engine Mechanic
- ☐ Radio Communications
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Quantity Production Paces America's Drive To Victory

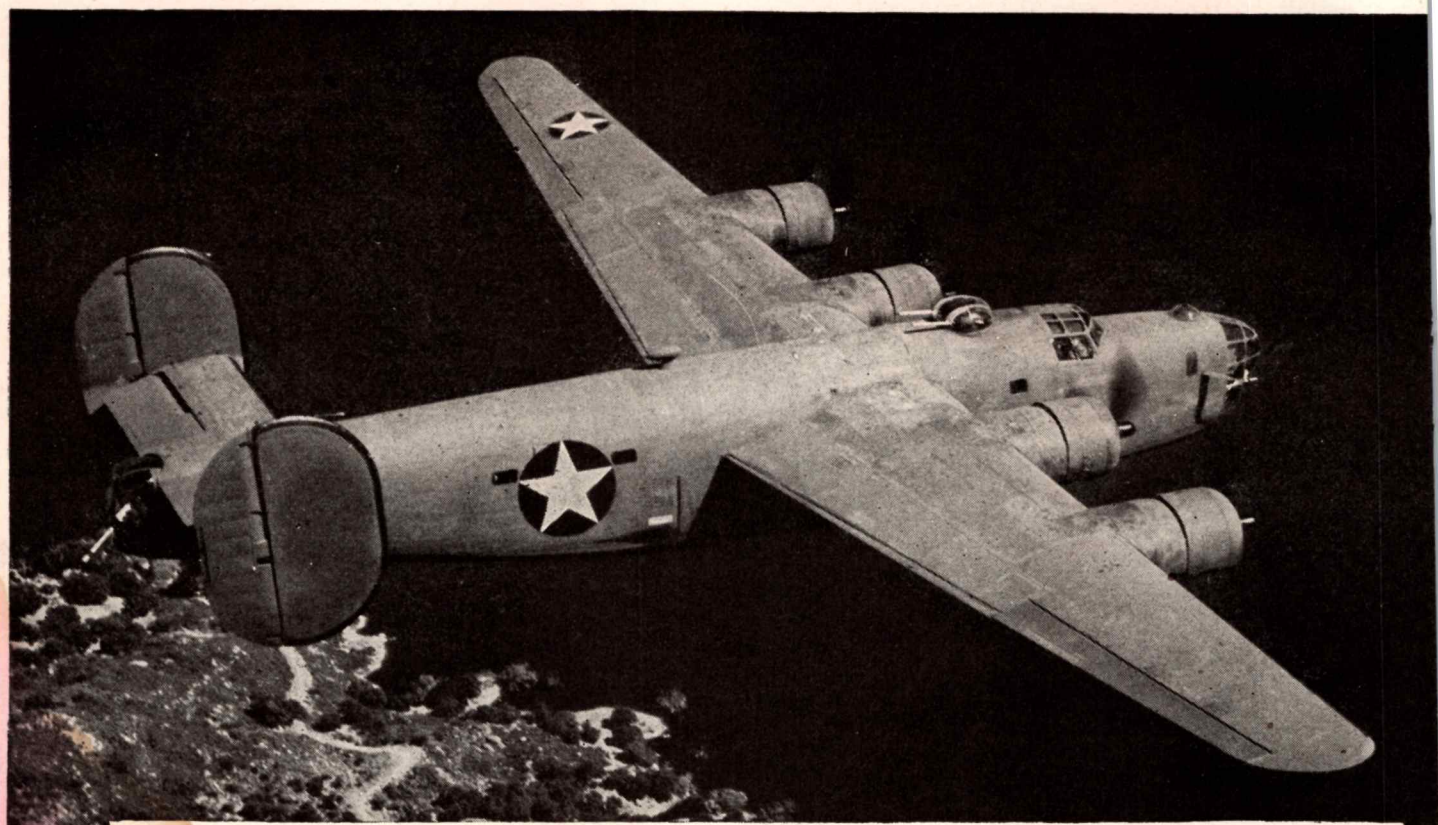
Today American industry is producing the tools of Victory in quantity and on time. Breeze is playing a vital part in keeping this vast flow of materiel on its way to the fighting fronts. Nearly every American fighting and bombing aircraft carries some essential equipment of Breeze manufacture.

Breeze products, which include Radio Ignition Shielding, Cartridge Engine Starters, Aircraft Armor Plate, Flexible Shielding Conduit and Fittings, Electrical Connectors, and Tab Controls and Actuators, are in service with mechanized units of all types on land, sea, and in the air. These products supplement many more bearing the Breeze Mark of Quality which are performing dependably today in battle zones the world over.

Breeze BREEZE MARK

CORPORATIONS INC., NEWARK, NEW JERSEY

Plexiglas ON THE



ON the Liberator—as on every type of military aircraft—PLEXIGLAS protects the battle stations, shields the fighting crew from terrific airstreams, yet permits accurate aim and fire during combat with the enemy.

Clear as the finest optical glass, yet only half as heavy, PLEXIGLAS is weatherproof, shatterproof, tough and strong.

Subjected to every kind of weathering, PLEXIGLAS has proved its permanent clarity and dimensional stability. It has earned the title of "aviation's standard transparent plastic"—and earned the right to fly on your peace-time planes tomorrow.

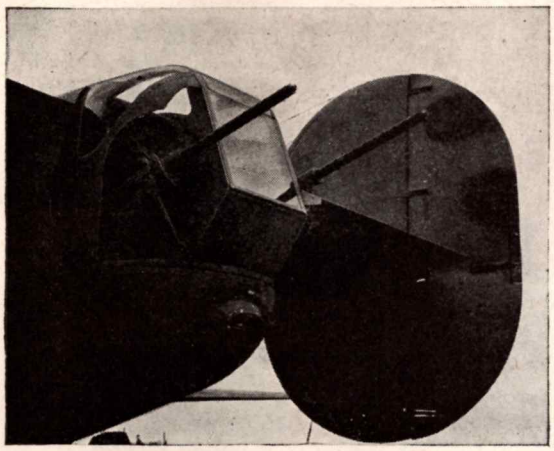
Only Rohm & Haas make PLEXIGLAS.

Photos Courtesy of Consolidated Aircraft Corporation

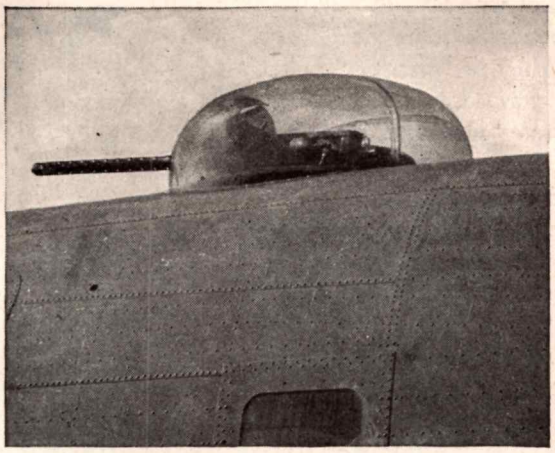
ROHM & HAAS

Manufacturers of Chemicals including Plastics . . . Synthetic Insecticides

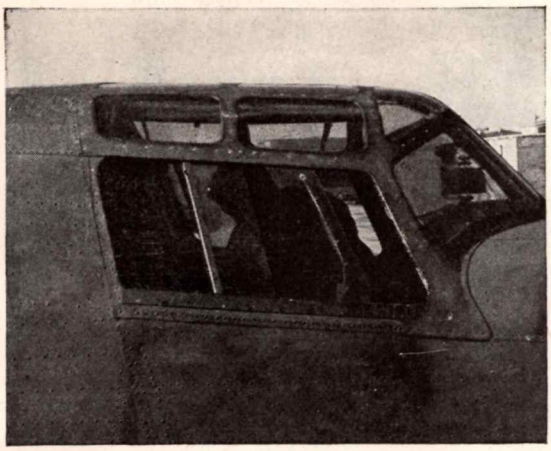
CONSOLIDATED B-24



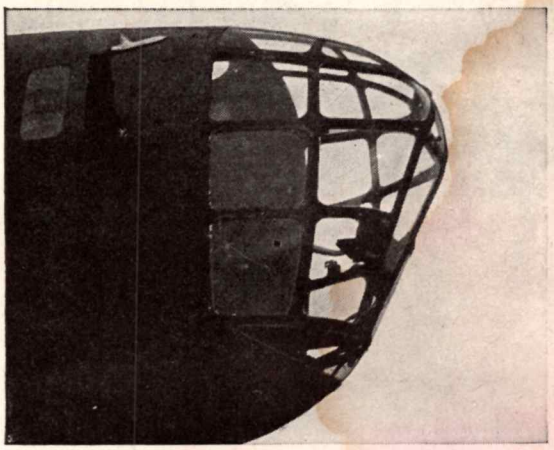
TO THE TAIL GUNNER all-around visibility is all-important. On the Liberator he has it because the top and sides of his strategic perch are made of crystal-clear PLEXIGLAS.



THE TOUGH TOP TURRET must be strong, flexible and shatterproof to withstand the weaving of the plane and the rapid spinning of the turret. This one-piece dome of PLEXIGLAS is the answer.



NOTICE THE COMPOUND CURVE of the PLEXIGLAS section on the upper front of the pilot's enclosure. Easily cut and formed, PLEXIGLAS aids in perfect streamlining.



THE PLEXIGLAS NOSE must stand up under 120° heat and −67° cold. In this severe service, PLEXIGLAS sections retain their optical clarity and strength indefinitely.

PLEXIGLAS *is the trade-mark, Reg. U. S. Pat. Off., for the acrylic resin thermoplastic sheets manufactured by the Rohm & Haas Company.*

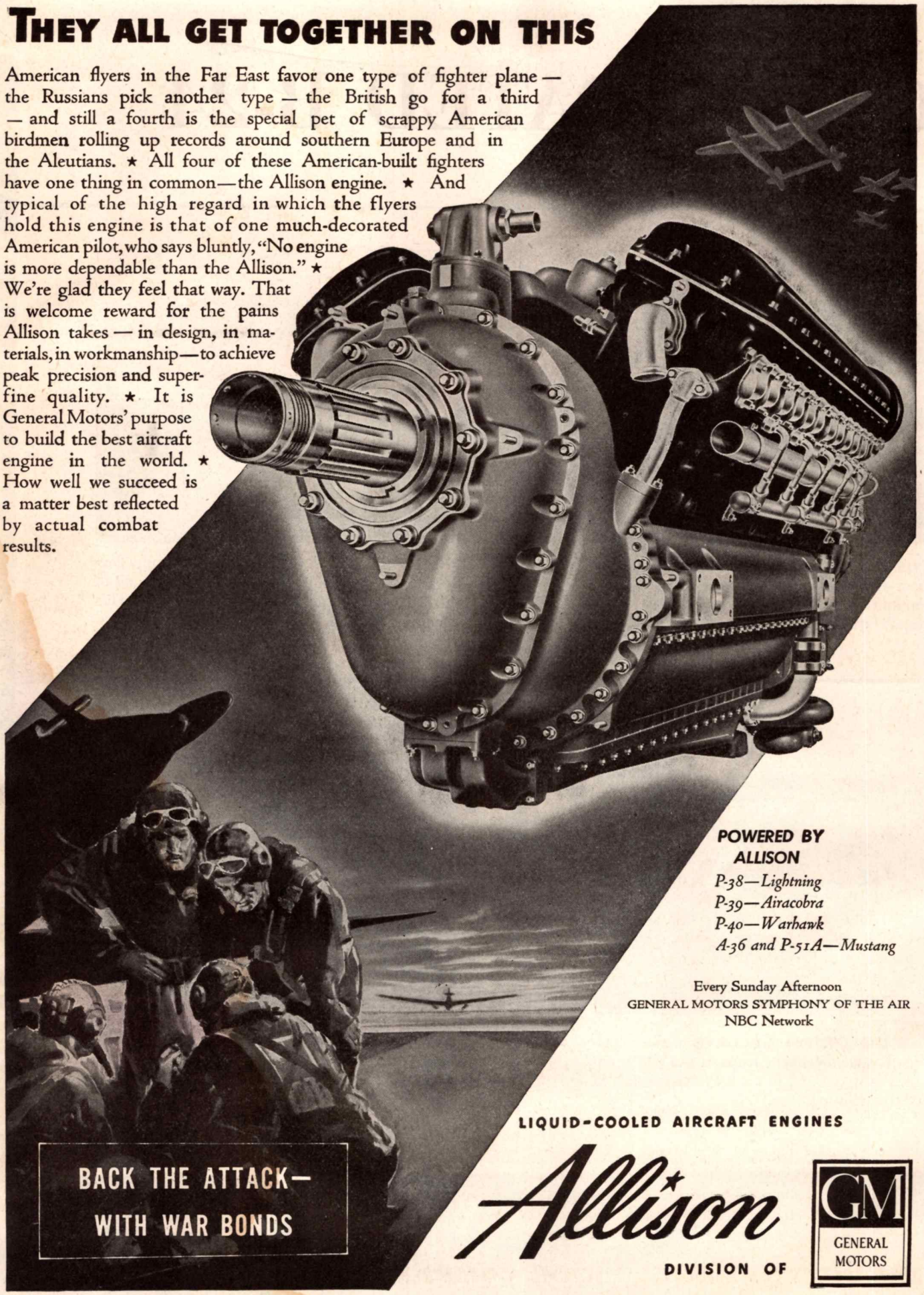
COMPANY

WASHINGTON SQUARE
PHILADELPHIA, PA.

Fungicides . . . Enzymes . . . Chemicals for the Leather, Textile and other Industries

THEY ALL GET TOGETHER ON THIS

American flyers in the Far East favor one type of fighter plane — the Russians pick another type — the British go for a third — and still a fourth is the special pet of scrappy American birdmen rolling up records around southern Europe and in the Aleutians. ★ All four of these American-built fighters have one thing in common—the Allison engine. ★ And typical of the high regard in which the flyers hold this engine is that of one much-decorated American pilot, who says bluntly, "No engine is more dependable than the Allison." ★ We're glad they feel that way. That is welcome reward for the pains Allison takes — in design, in materials, in workmanship—to achieve peak precision and superfine quality. ★ It is General Motors' purpose to build the best aircraft engine in the world. ★ How well we succeed is a matter best reflected by actual combat results.



POWERED BY ALLISON

P-38—Lightning
P-39—Airacobra
P-40—Warhawk
A-36 and P-51A—Mustang

Every Sunday Afternoon
GENERAL MOTORS SYMPHONY OF THE AIR
NBC Network

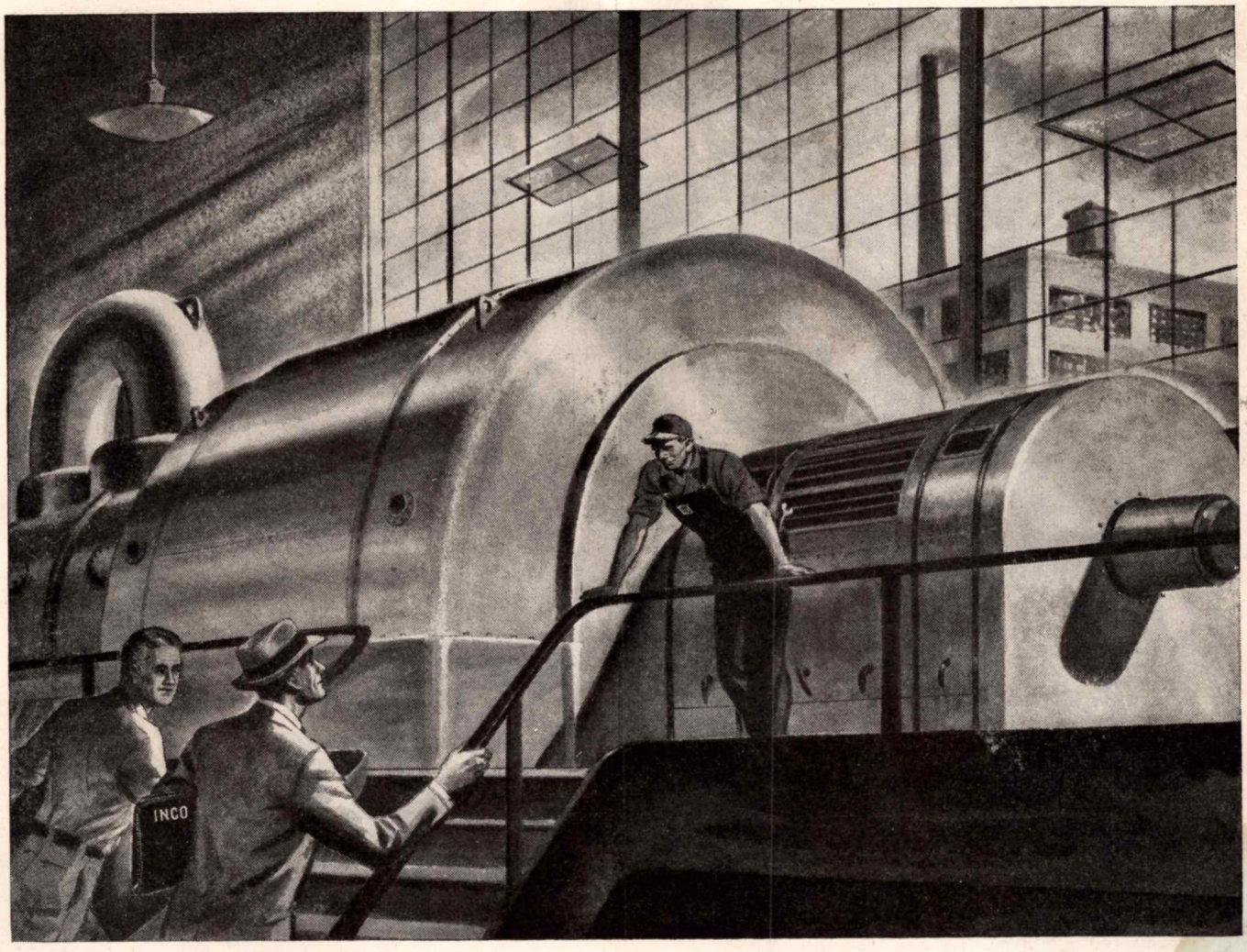
BACK THE ATTACK—
WITH WAR BONDS

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF

GM
GENERAL MOTORS



NICKEL AIDS THE POWER INDUSTRY

to KEEP 'EM OPERATING!

In this day of acute shortages of almost everything, power plant engineers are doing an amazing job of meeting demands for power—the power to keep 'em operating.

Part of this success is due to their foresight in specifying materials that assure long life and withstand the added hardships imposed by ever-increasing peak-load demands.

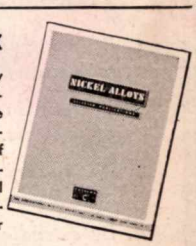
With the production of tanks, guns, and planes dependent upon power capacity, Nickel makes a valuable contribution towards uninterrupted operation, through the improved properties it imparts to ferrous and non-ferrous alloys used in power plant equipment.

So today the exigencies of war illustrate more clearly than ever the simple truth of the familiar axiom, "A little Nickel goes a long way" toward increasing the dependability of power plant equipment, from turbine blades to high pressure valves, from flange bolts to shaft forgings.

The technical staff of International Nickel has been privileged to cooperate with the power plant engineers and Government authorities who have made possible the great increases in power on which so much of the war effort depends. INCO engineers and metallurgists offer counsel and data to all who desire assistance in the selection, fabrication, and heat treatment of ferrous and non-ferrous metals.

New Catalog Index

New Catalog C makes it easy for you to get Nickel literature. It gives you capsule synopses of booklets and bulletins on a wide variety of subjects—from industrial applications to metallurgical data and working instructions. Why not send for your copy of Catalog C today?

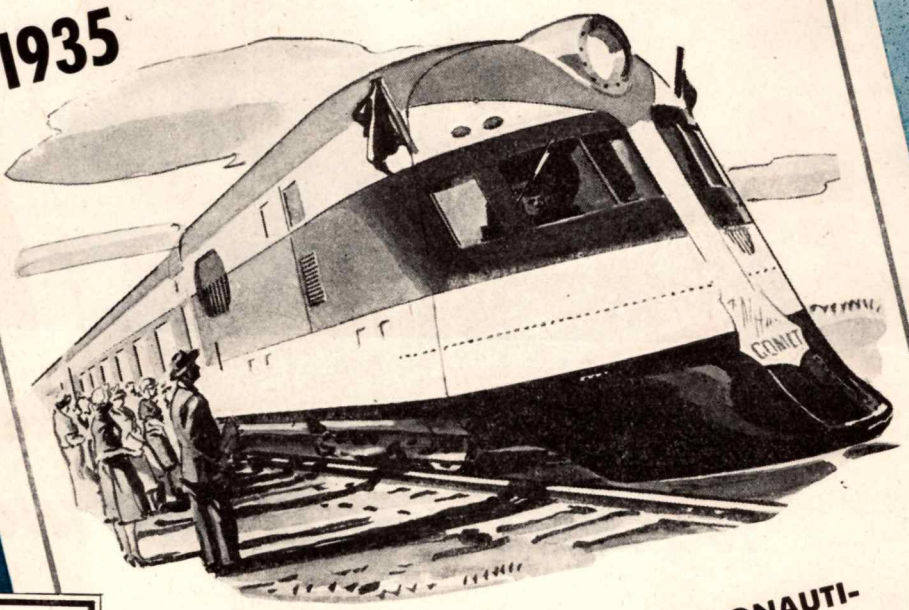


★ Nickel ★

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall St., New York 5, N. Y.*

Trail Blazing in the Skies

1935

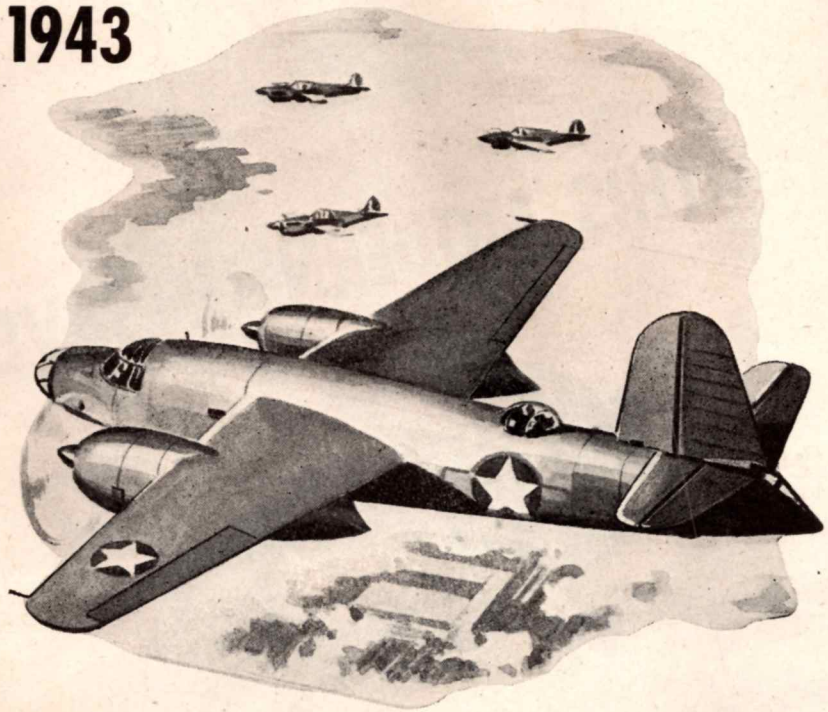


FIRST STREAMLINER BUILT ON AERONAUTICAL PRINCIPLES was the famous "Comet," designed and fabricated by Goodyear's Aircraft division in 1935 for the New York, New Haven & Hartford Railroad. In the Comet, lightness-with-strength was achieved by designing roof, sides and floor of the cars as main load-carrying elements of the structure — the same stressed-skin or monocoque construction widely used in aircraft. This undertaking was part of Goodyear's early work in exploring the possibilities of light aircraft metals that contributed to the development of the superior alloys in use today.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRCRAFT INDUSTRY

1. *By constructing subassemblies to manufacturers' specifications.*
2. *By designing parts for all types of airplanes.*
3. *By re-engineering parts for mass production.*
4. *By extending our research facilities to aid the solution of any design or engineering problem.*
5. *By building complete airplanes and airships.*

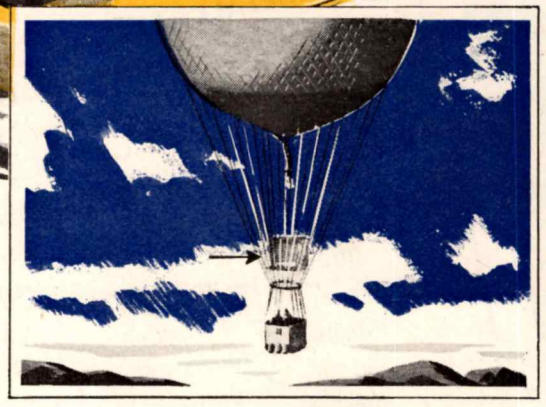
1943



METALCRAFTING EXPERIENCE THAT STREAMLINES MANY PRODUCTION PROBLEMS. As a result of its long experience in aeronautical design and light-metal fabrication, Goodyear is today one of the largest producers of subassemblies for all types of aircraft. These include complete empennages and wing panel assemblies, and all their component parts, cabin structures, floats, and float mechanisms—for both "hot" fighters and heavy bombers. And in addition Goodyear is one of the producers of the Corsair — a fact that bespeaks Goodyear's ability to handle complete and intricate production problems on a large scale.

Back the attack with WAR BONDS

THIS MODERN LIFESAVER



1919—*rubber life raft (arrow) carried on balloon*

was first built for racing balloons

THE amazingly seaworthy rubber life rafts that have saved so many airmen in this war, had their beginning on Goodyear racing balloons a quarter century ago. From these first rafts, carried inflated, lashed to the balloon rigging, came the inspiration for the modern self-inflating type first supplied by Goodyear to the Army and Navy. Today as a result of wartime experience, these craft are equipped with many new innovations to ease the castaways' lot. But most important of all is the rugged, sturdy workmanship that endows these rafts with strength to withstand buffeting seas for weeks. The life raft in which Captain Rickenbacker and his companions were rescued after 21 days afloat was Goodyear-built — as was that on which the heroes of "The Raft" sailed for five weeks.

Pliofilm, Airwheel –T.M.'s The Goodyear Tire & Rubber Company

Back the attack with WAR BONDS

AERONAUTICAL RUBBER GOODS

AMERICAN AIRCRAFT

BEST IN BRAKES

The famous Goodyear hydraulic disc brake is universally used today on all types of airplanes because of its high efficiency and dependability. That is the reason it is used on some of the largest new superbombers and cargo ships now being built—its tremendous reserve power insures safe, quick, smooth stops in comparatively short distance.

KEEPS OUT MOISTURE GREMLINS

All American military aircraft engines are now sealed in a dehydrated atmosphere without grease-packing, in moisture-vapor-air-tight envelopes of Pliofilm, supplied by Goodyear. Pliofilm's ability to seal out corroding moisture makes it the perfect shipping package for all parts and instruments requiring such protection.

A TIRE FOR EVERY NEED

Goodyear's line of airplane tires is complete with specially designed casings and tubes for all types of service — Airwheel, Intermediate, Streamline, Smooth Contour, High Pressure, Channel Tread, Ice-Grip and all styles of tail-wheel tires, both pneumatic and solid. Built with cotton, rayon and nylon carcass construction, depending on service requirements.

OUR ENGINEERS ARE AT YOUR SERVICE

With a background of more than 30 years' experience in developing tires, tubes, wheels, brakes and other aircraft accessories, Goodyear engineers are ready to help you work out any problem involving such products, particularly those made of rubber—either natural or synthetic. Address: Goodyear Aeronautics Dept., Akron 16, Ohio, or Los Angeles 54, California.

GOODYEAR

GOODYEAR

THE GREATEST NAME IN RUBBER

TIRES • TUBES • WHEELS • BRAKES

The world's finest piston rings for these world-famous aircraft engines—

Allison • Wright • Buick-built Pratt & Whitney

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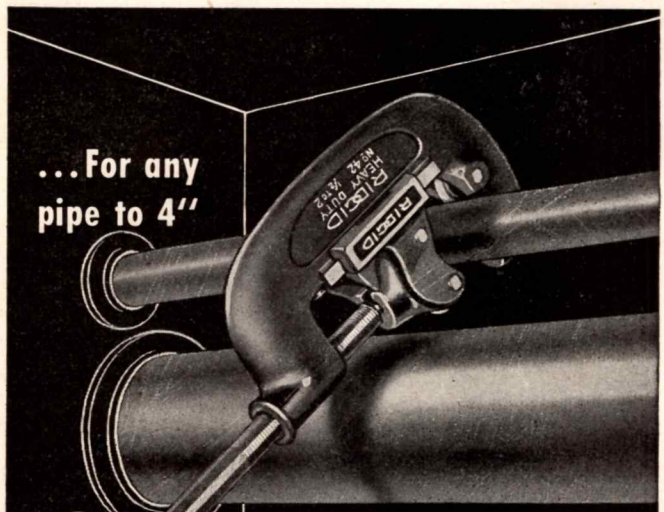
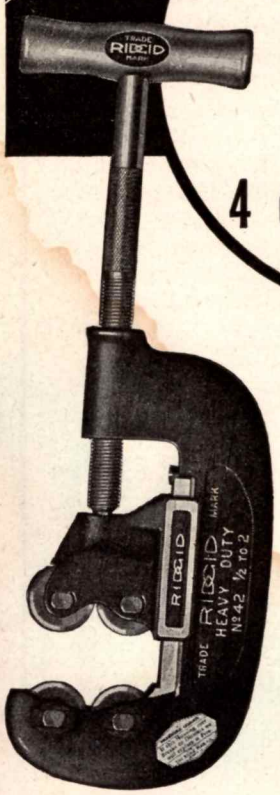
The Perfect Circle Companies

Hagerstown, Indiana • Richmond, Indiana • Newcastle, Indiana • Tipton, Indiana • Toronto, Ontario, **Canada**

Perfect Circle has once again written
a new page in piston ring history.



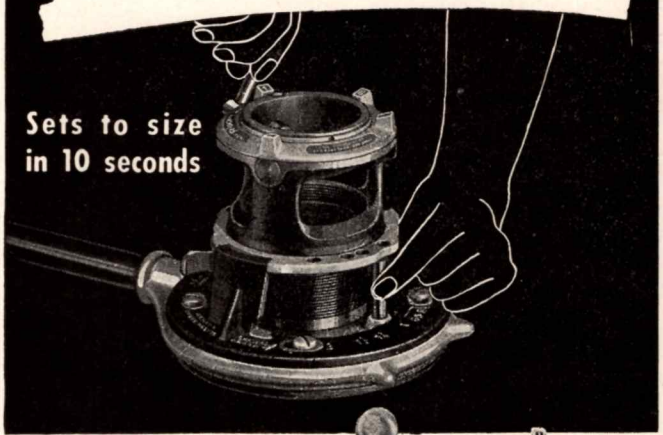
New Type RIDGID CUTTER with 4 cutting wheels

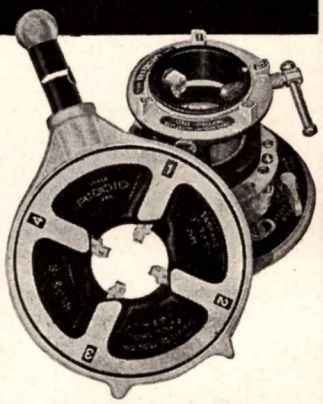


Cuts pipe if there's room for a quarter turn.

WHEN you have pipe to cut in close quarters, in a trench, near a wall or other pipes it's easier with this new RIDGID Heavy-Duty Cutter. The handle is short; and you use *four* heavy-duty cutting wheels *that roll right through pipe* up to 4" with a minimum of burr. The tough malleable frame holds perfect alignment, always cuts true. Comes in two sizes — No. 42, and No. 44. For tight-spot pipe cutting . . . ask your Supply House for the *new* RIDGIDs.

Nearest thing to an automatic 1" to 2" PIPE THREADER self-contained RIDGID No. 65R





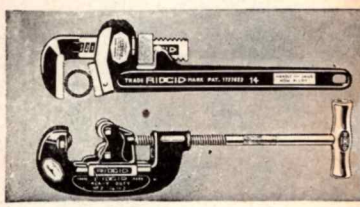
YOU set it to thread 1", 1¼", 1½" or 2" pipe by a simple 10 second adjustment. You set the mistake-proof workholder to pipe size by an instant turn of the gauge ring, tighten only one screw — no bushings needed. It's almost automatic. No extra chaser dies to carry around — one high-speed steel set stays in the die stock, cuts micrometer perfect threads on all four sizes of pipe with easy ratcheted strokes. Steel and malleable durability. For smooth speedy and easy threading . . . ask your Supply House for this self-contained RIDGID No. 65R.

Buy RIDGID Pipe Tools at Supply Houses Everywhere

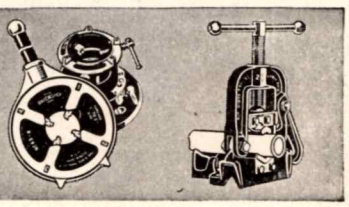
RIDGID

★ PIPE TOOLS ★

THE RIDGE TOOL COMPANY
ELYRIA, OHIO, U.S.A.

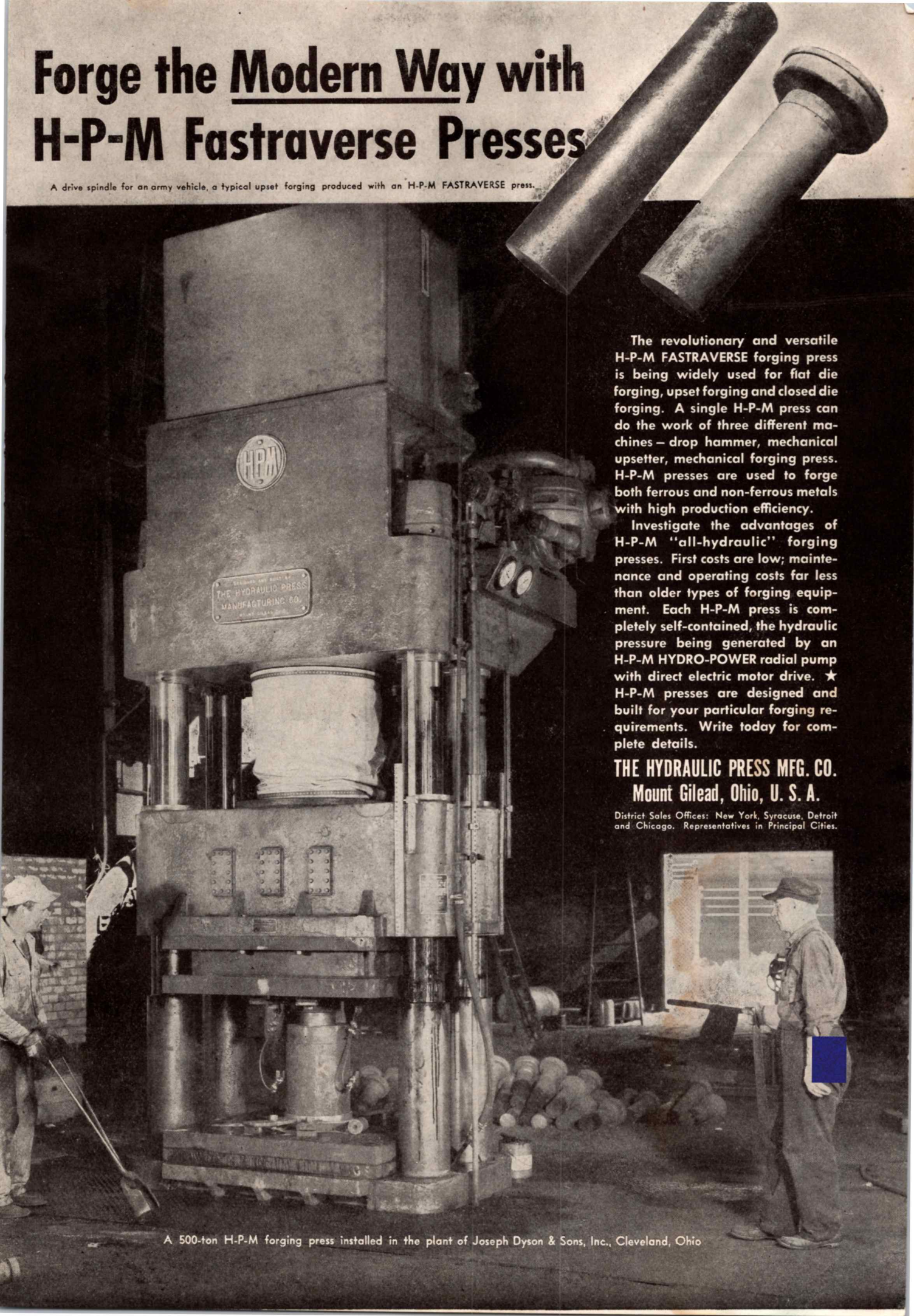


Fast-Working Tools for War . . . and the Busy Peace That's Coming



Forge the Modern Way with H-P-M Fastraverse Presses

A drive spindle for an army vehicle, a typical upset forging produced with an H-P-M FASTRAVERSE press.



The revolutionary and versatile H-P-M FASTRAVERSE forging press is being widely used for flat die forging, upset forging and closed die forging. A single H-P-M press can do the work of three different machines – drop hammer, mechanical upsetter, mechanical forging press. H-P-M presses are used to forge both ferrous and non-ferrous metals with high production efficiency.

Investigate the advantages of H-P-M "all-hydraulic" forging presses. First costs are low; maintenance and operating costs far less than older types of forging equipment. Each H-P-M press is completely self-contained, the hydraulic pressure being generated by an H-P-M HYDRO-POWER radial pump with direct electric motor drive. ★ H-P-M presses are designed and built for your particular forging requirements. Write today for complete details.

THE HYDRAULIC PRESS MFG. CO.
Mount Gilead, Ohio, U. S. A.

District Sales Offices: New York, Syracuse, Detroit and Chicago. Representatives in Principal Cities.

A 500-ton H-P-M forging press installed in the plant of Joseph Dyson & Sons, Inc., Cleveland, Ohio

Mental production, too, is streamlined

J. L. McClane—*Contracts Manager*

"I consider the Dictaphone indispensable. It is never absent. It is always there when I need it and has an inexhaustible capacity for taking work. Couldn't do without it."

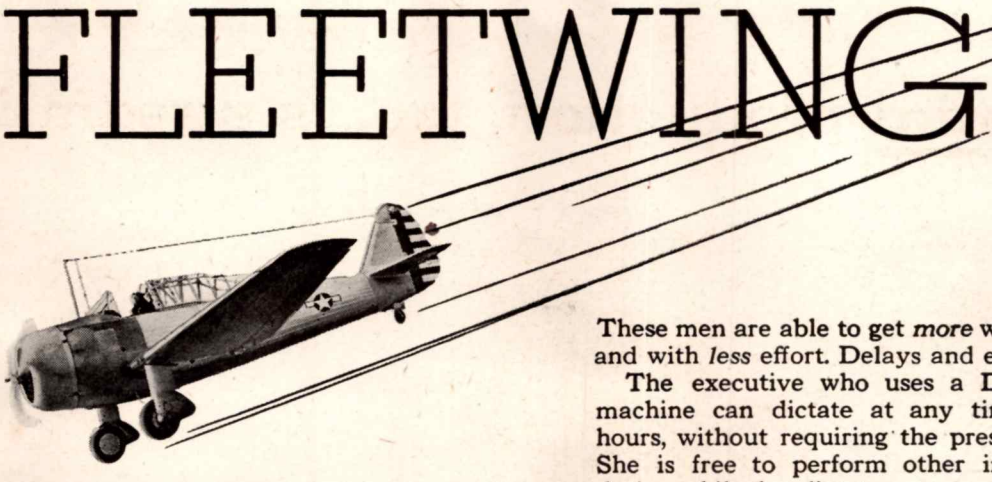
R. W. Ayer—*Chief Engineer*

"I've been a Dictaphone enthusiast for fifteen years. The Dictaphone's availability any time during the day saves me many hours—hours that are mighty important in our aircraft engineering work."

Miss Margaret Brennan—*Secretary*

"I like to use a Dictaphone because it eliminates lost motion and cuts down errors. Besides giving me the satisfaction of doing better work—and more of it—it increases my efficiency and makes me more valuable to my employer."

at FLEETWINGS . . .



AS one of the largest aircraft parts sub-contractors in the country, Fleetwings, Inc., a division of Kaiser Cargo, Inc., has made production records on wing and tail assemblies for many of the best-known fighters and bombers now flowing down the assembly lines. Fleetwings also pioneered the stainless steel BT-12, a basic trainer for the Army.

These achievements would not be possible without the swift and orderly clearance of the mountains of paper-work which are involved. Mental production has to be streamlined just as effectively as plant operation. That is why Fleetwings executives use the Dictaphone method to dictate notes, instructions, specifications and routine follow-through of all kinds.

These men are able to get *more* work done . . . quickly and with *less* effort. Delays and errors are minimized.

The executive who uses a Dictaphone dictating machine can dictate at any time, before or after hours, without requiring the presence of a secretary. She is free to perform other important secretarial duties while he dictates.

This sort of coordinated effort saves precious *time*, which is today most important of all. For war must be *thought* out before it can be *fought* out.

Plenty of war-thinking is being done faster and better today because of Dictaphone, and the results show in planes, tanks and ships that are going into action *sooner*, for a speedier victory.

Phone your local Dictaphone office, or write or wire us for information on how Dictaphone can double your ability to get things done.

DICTAPHONE CORPORATION
420 Lexington Avenue New York 17, N. Y.

Mrs. Margaret Laird
Secretary to C. L. Nielsen

"My association with the Dictaphone has been pleasant and profitable. I don't have to write everything twice—in shorthand and on the typewriter—and much time is gained for other work."

C. L. Nielsen—*Controller*

"My second secretary. As much as I admire the efficiency of my regular secretary, I'm certain that neither of us could get along as well without this dependable silent partner. It absorbs long, detailed reports with utmost accuracy and minimum of time."

DICTAPHONE DICTATING AND RECORDING EQUIPMENT

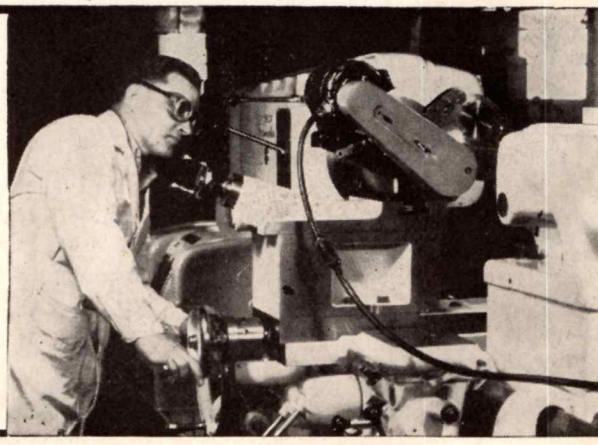
The word DICTAPHONE is the registered trade-mark of Dictaphone Corporation, makers of dictating machines and other sound recording and reproducing equipment bearing said trade-mark.

Dumore

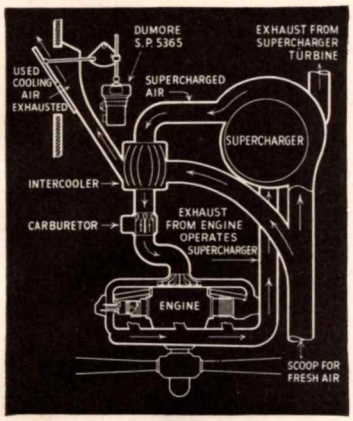
PRECISION GRINDERS

FOR BETTER
MAINTENANCE AND REPAIR

Dumore Precision Grinder grinding crankshaft of P & W engine at U. A. L. central maintenance base, Cheyenne, Wyoming.



THE HEAT OFF!

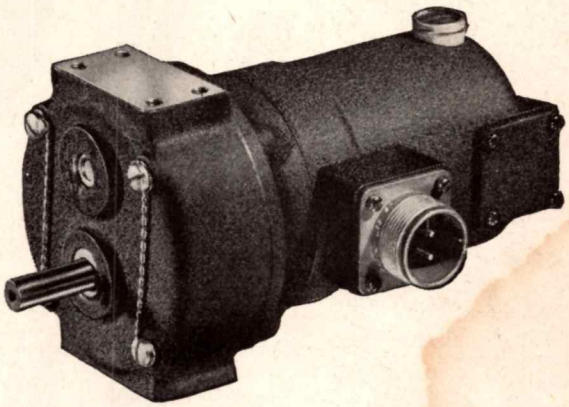


"ALL our planes returned to base!"—that this phrase appears more and more frequently in reports of bombing raids by the A. A. F., is due to perfection of the precision bombing technique, the skill and daring of our bombing crews, and to the improved protection from enemy interceptors provided by the high-flying P-47 Thunderbolts! Many elements combine to give these ships their climbing speed and high operating ceiling, most important being the super-charged engine. But this very feature introduces another problem, in that the high temperature of the air compressed by the turbo-supercharger tends to cause pre-ignition and knock, with serious loss of power. To offset this danger, the intercooler removes the excess heat from the engine intake air before it goes to the carburetor. The current of cooling air is controlled by opening or closing a door in the air-passage, located in the rear part of the fuselage.

"DOORMAN" FOR THE INTERCOOLER!

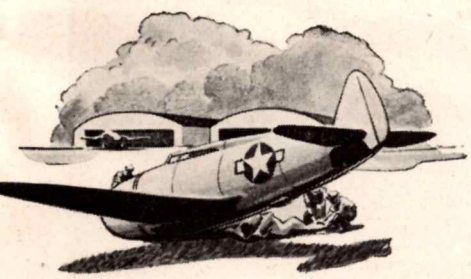
Operating the intercooler door, as required by varying conditions of speed, height and temperature, is the vital function of this Dumore Aeromotor, SP5365. To minimize overtravel and resultant jamming of the door, a magnetic brake was added to the original model, increasing its overall length only 5/8", though 3/4" was allowed by the plane builder. This motor is conditioned to operate efficiently under temperatures ranging from below zero to 165° F. and in the rarefied atmosphere of 40,000 feet altitude, necessitating special provisions for lubrication and special brushes.

In the aerial battlefields today, and on world skyways of the future, Dumore Aeromotors will power the many accessories that insure safety, operating ease and comfort. Dumore engineers welcome your inquiries and offer their aid and suggestions in your application of Dumore Aeromotors.



FOR EXTRA POWER HOURS Dumore

Headquarters for Fractional Horsepower Motors



"IT TAKES TOOLS, TOO"

From flyers to G. H. Q., the combat forces are unstinting in their praise of the ground crews, the men who by long hours of labor, skill amounting to genius, and sometimes through sheer determination, keep the planes fit to fly and fight. But these men themselves are the first to admit that the utmost skill and determination are of slight avail in servicing modern planes and especially the engines, without precision tools. In many an Air Corps repair depot, Dumore grinders are delivering the same ten-thousandth-inch accuracy that is expected of them in the factory back home! Mounted on lathe, miller, shaper or any available machine base, these precision tools are capable of any grinding operation, external or internal to a depth of 24 inches, at speeds up to 42,500 r. p. m.! Consult your industrial distributor, or write for complete catalog to

THE DUMORE COMPANY, RACINE, WISCONSIN

48% Critical Material SAVED in Turnbuckle Production

RELIABLE LEADS INDUSTRY by Devising New Methods

The Reliable Electric Company of Chicago, after many months of close cooperation with the Army Air Force Materials Distribution Branch, Production Engineering Department and Aircraft Laboratory, and endless experiments, have effected savings of 48% in critical material and 100% in critical machine time in the production of turnbuckle barrels, and 91% in critical material and 96% critical machine time in the production of turnbuckle forks, to provide prompt delivery of Aircraft Turnbuckles.

Value of Experiments

As an indication of the value of these developments, the saving on 100,000 AN150-32L Turnbuckles, which is a moderate quantity of an average size, is 60,800 lbs. of molybdenum steel and 9,100 lbs. of brass.

The bottleneck in skilled operators and critical machine tools—largely on turret lathes and multiple spindle automatic screw machines—is relieved to the extent of 22,725 hours on this quantity. This time can be devoted to the production of other critical "AN" parts by placing fork and barrel orders with Reliable.

The Reliable Electric Company normally devotes its entire capacity and laboratory to the development and manufacture of telephone and power line equipment. At present this company is applying its modern facilities in many fields with similar results to those mentioned above, from which interesting future communication and power equipment developments can be expected.

A N 150 Turnbuckle Assembly Fork

A N Part No.

AN150-16S
AN150-16L
AN150-32S
AN150-32L
AN150-46S
AN150-46L

A N 155 Barrel Turnbuckle

A N Part No.

AN155-8S
AN155-16S
AN155-16L
AN155-32S
AN155-32L
AN155-46S
AN155-46L
AN155-61L
AN155-80L

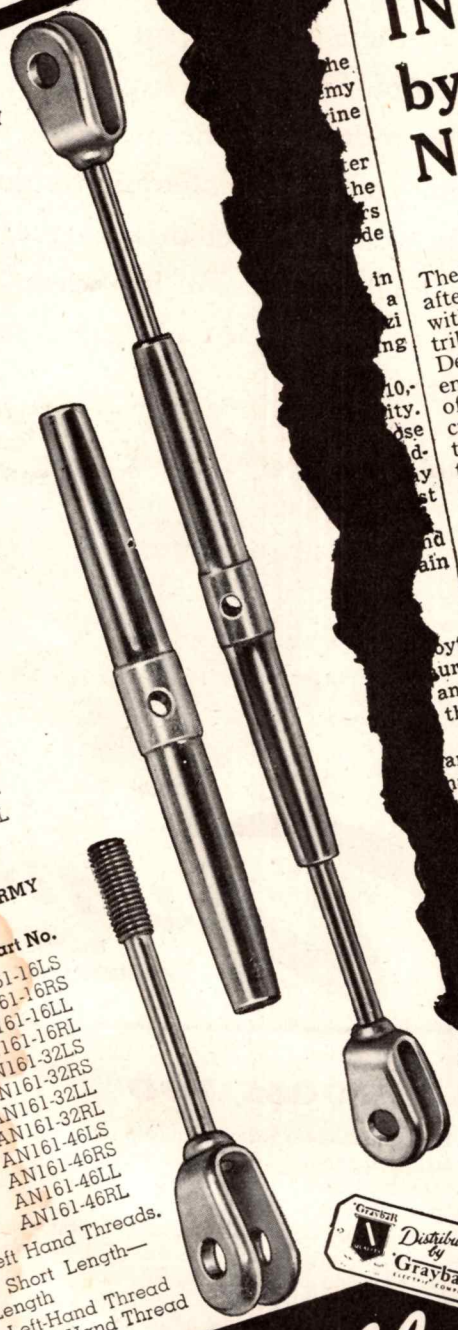
A N 161 Fork Turnbuckle U.S. ARMY AIR FORCE

Part No.	A N Part No.
Air Force X43B2342-16LS	*AN161-16LS
Air Force X43B2342-16RS	**AN161-16RS
Air Force X43B2342-16LL	AN161-16LL
Air Force X43B2342-16RL	AN161-16RL
Air Force X43B2342-32LS	AN161-32LS
Air Force X43B2342-32RS	AN161-32RS
Air Force X43B2342-32LL	AN161-32LL
Air Force X43B2342-32RL	AN161-32RL
Air Force X43B2342-46LS	AN161-46LS
Air Force X43B2342-46RS	AN161-46RS
Air Force X43B2342-46LL	AN161-46LL
Air Force X43B2342-46RL	AN161-46RL

Furnished in Right and Left Hand Threads.

*AN161L(S) S means Short Length—
L Long Length

**AN161(L)S L means Left-Hand Thread
***AN161(R)S R means Right-Hand Thread



Distributed by GraybaR

Reliable
ELECTRIC COMPANY
3145 CARROLL AVENUE, CHICAGO

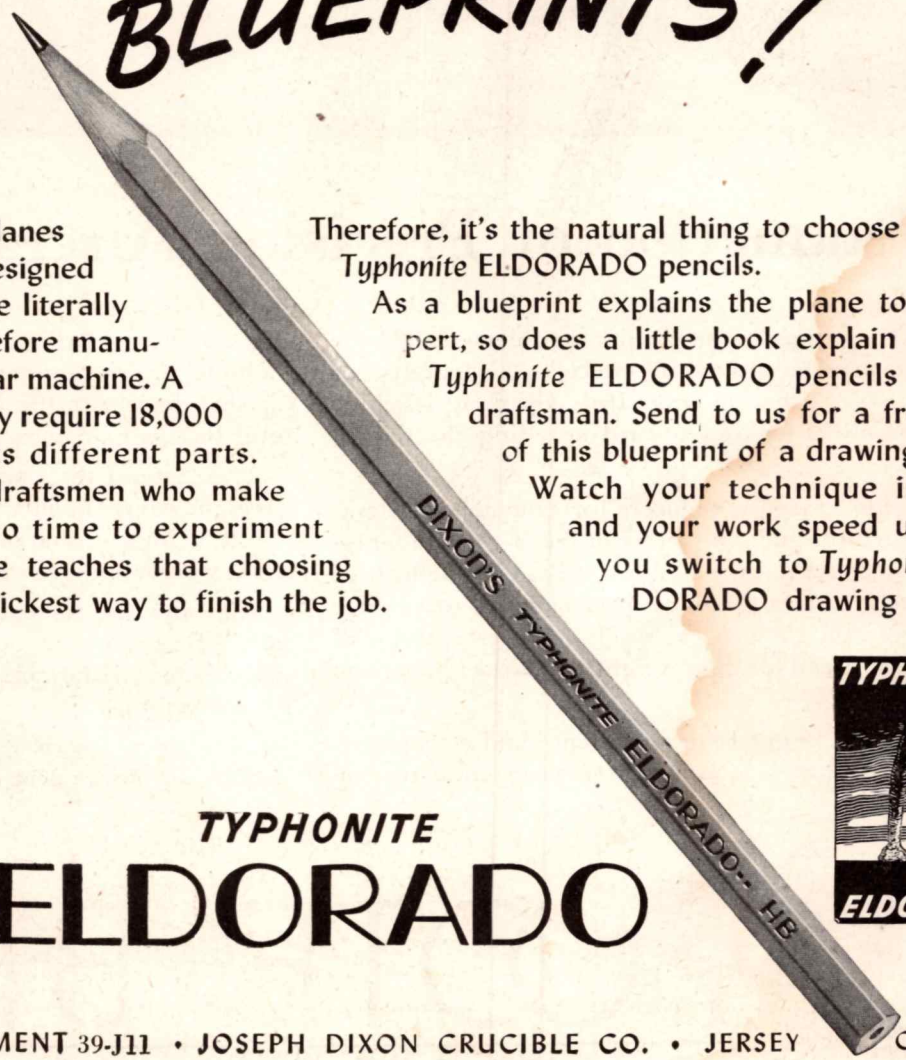
DECISIVE BLUEPRINTS!

New tanks, guns, ships, planes are constantly being designed on paper. There must be literally thousands of designs before manufacturing begins on a war machine. A bomber, for instance, may require 18,000 detailed drawings of its different parts.

You designers and draftsmen who make these drawings have no time to experiment with pencils. Experience teaches that choosing the best pencil is the quickest way to finish the job.

Therefore, it's the natural thing to choose Dixon's *Typhonite* ELDORADO pencils.

As a blueprint explains the plane to an expert, so does a little book explain Dixon's *Typhonite* ELDORADO pencils to the draftsman. Send to us for a free copy of this blueprint of a drawing pencil. Watch your technique improve and your work speed up when you switch to *Typhonite* ELDORADO drawing pencils.



TYPHONITE

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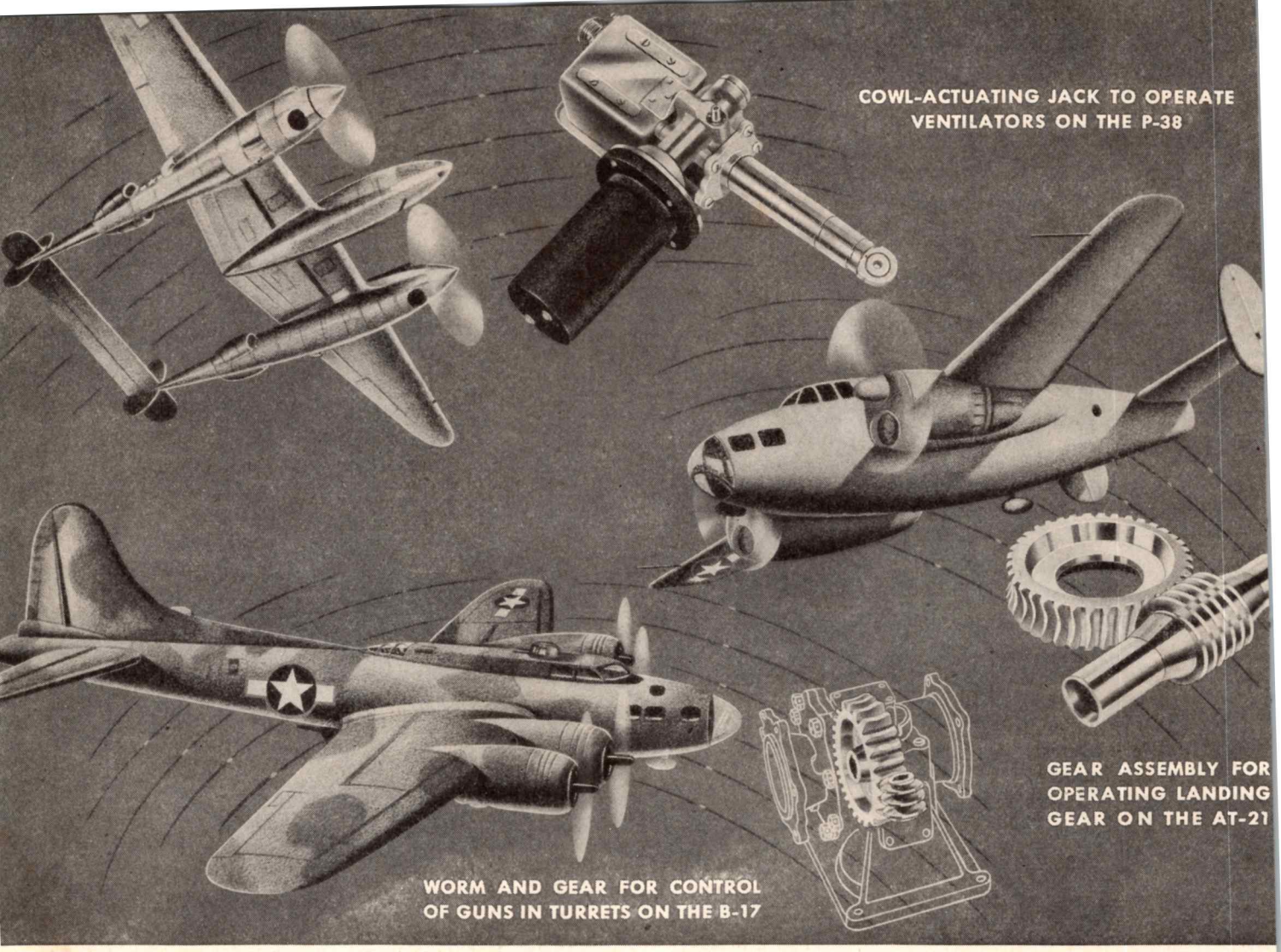
PENCIL SALES DEPARTMENT 39-J11 • JOSEPH DIXON CRUCIBLE CO. • JERSEY CITY, N. J.



Production of Precision Aircraft Devices

SOLVING intricate production problems called for in the manufacture of high-precision aircraft devices is another contribution Foote Bros. Gear and Machine Corporation is making toward speeding the day of Victory.

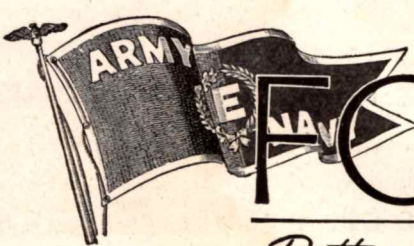
Precision gears for reducers for azimuth and elevation control of guns in turrets in the B-17 bombers—gear assemblies to raise and lower the landing gear of the AT-21 trainers—cowl actuating jacks to operate ventilators on oil coolers on P-38 interceptors—all these devices call for light weight coupled with extreme precision.

Foote Bros. engineering experience and manufacturing "know-how" acquired in the production of precision gears in tremendous quantities for Pratt & Whitney aircraft engines assure the production of these special devices in the quantities required to meet the ever-increasing demand of our global air force.

It is natural that many manufacturers of airplanes, airplane engines and airplane parts recognize in Foote Bros. a logical source for gears and devices where light weight and extreme precision are essential.

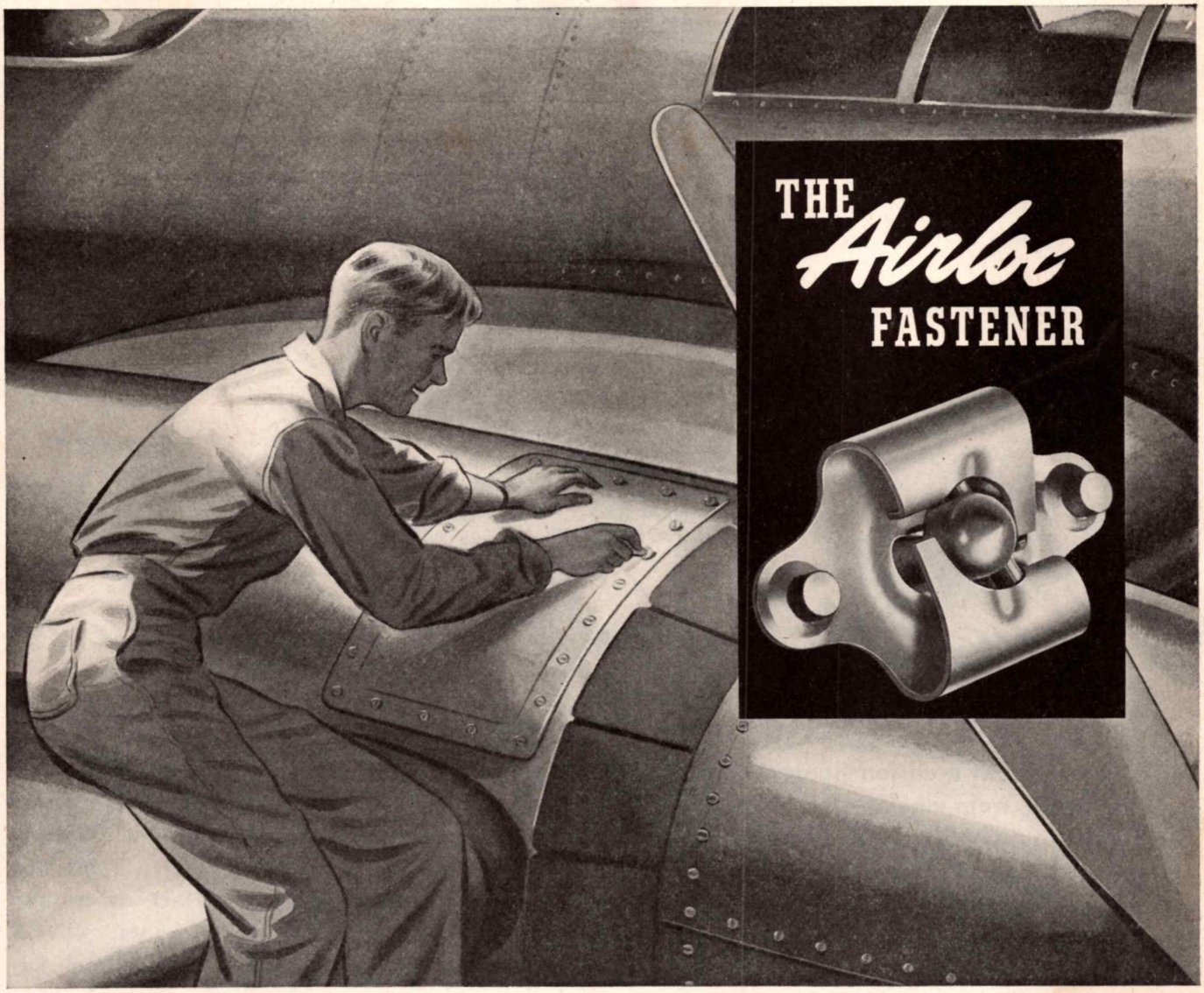
After the war, the experience gained in the manufacture of such gears and devices promises American manufacturers a new era in the economical transmission of power.

FOOTE BROS. GEAR AND MACHINE CORPORATION
5225 South Western Boulevard • Chicago, Illinois



FOOTE BROS.

Better Power Transmission Through Better Gears



First in Service

ASK THE MEN WHO USE THEM

THE PROOF of a fastener is the way it works. Tests for shear strength, tension, vibration and endurance cannot give the whole story. But ask a ground crew why they rate Airloc fasteners *first* in actual service and they will tell you . . . .

- *When the Airloc is locked, it stays locked.*
- *When the Airloc is unlocked, they can see it a dozen feet away.*

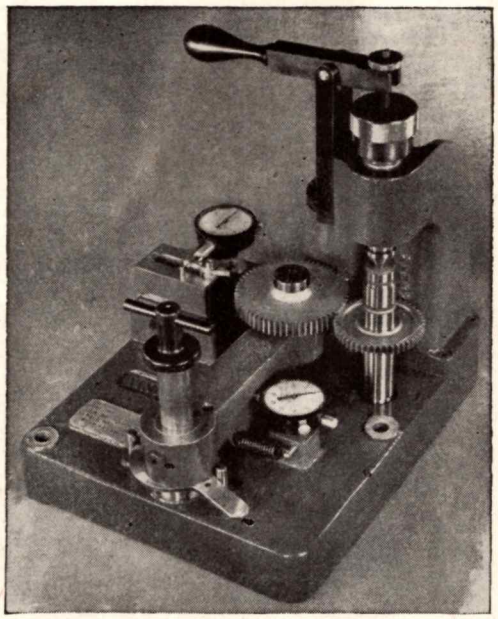
Thus the Airloc fastener, primarily designed for safety in the air, has demonstrated to the men on the service end that cowling, access doors and inspection plates can be checked at a glance. Inspection time is saved. And the risk that cowling will tear loose at high speeds — due to faulty locking — is eliminated. Write for a copy of the new Airloc catalog. Address Dept. D-11.

UNITED-CARR FASTENER CORP.

CAMBRIDGE 42, MASSACHUSETTS

THE DOT LINE OF FASTENERS

The Airloc is one of many fasteners we make for the armed services



Almost everything that moves, uses

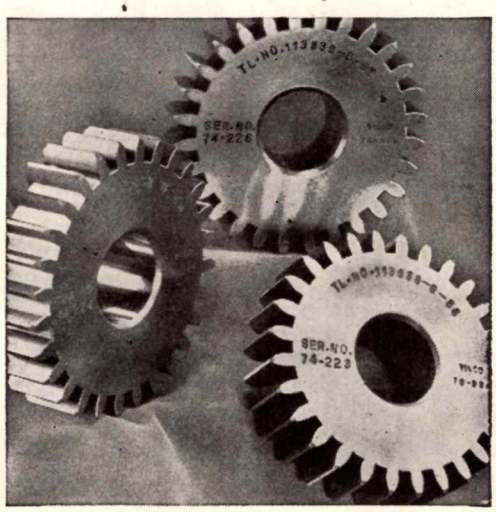
GEARS

Tanks rolling from invasion barges—jeeps dashing and bouncing up the beaches—planes covering the attack from above—more barges, filled with our warriors, speeding toward the shore—mounted guns blazing destruction to the enemy—these and many more of the Victory-producing products made in America for the United Nations, rely upon GEARS for the success of their motive power. Not just gears, but gears made as nearly perfect as human skill and precision machinery can produce. For the checking of production gears, VINCO has made, during the past quarter century, precision master gears and gear rolling fixtures. These examples of VINCO quality represent the ultimate in the art of precision manufacture.

Millionths of an inch for sale by

VINCO

HEAD OFFICE:
DETROIT, MICH.



NEW YORK, N.Y.
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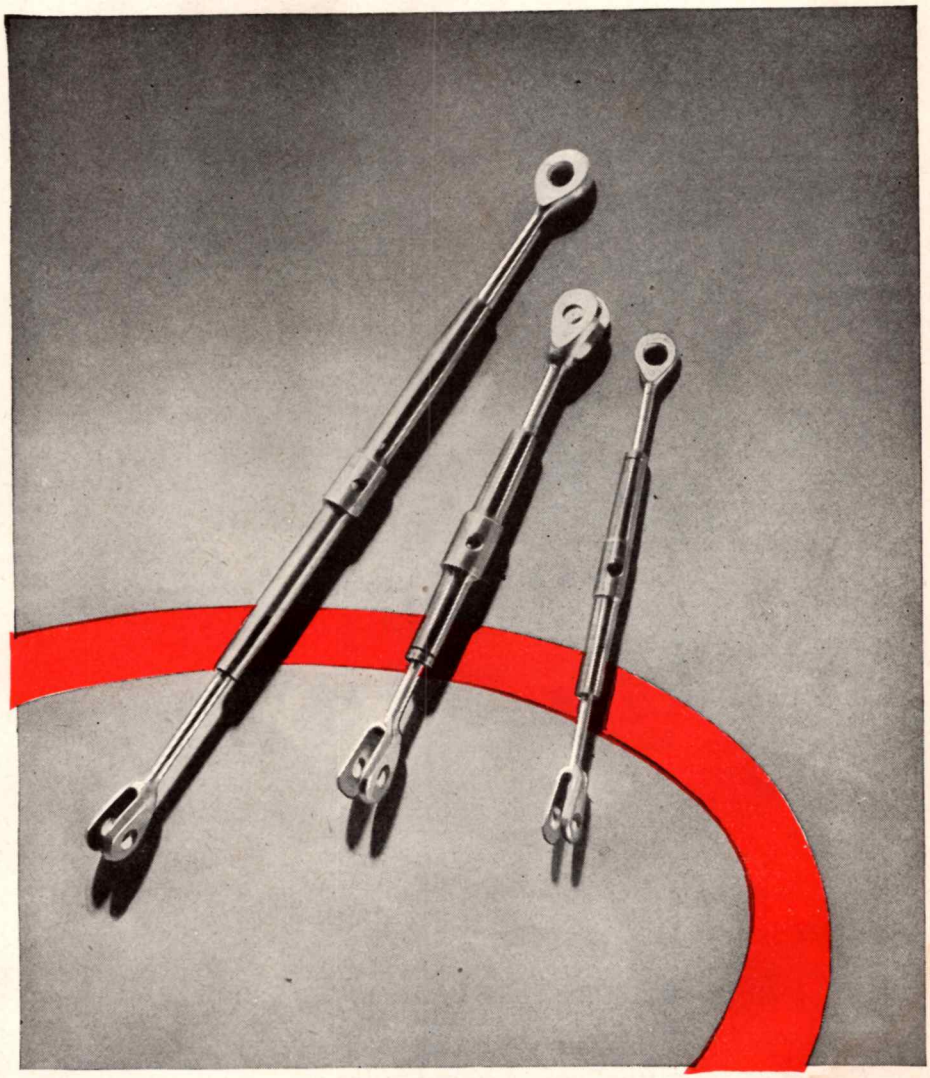
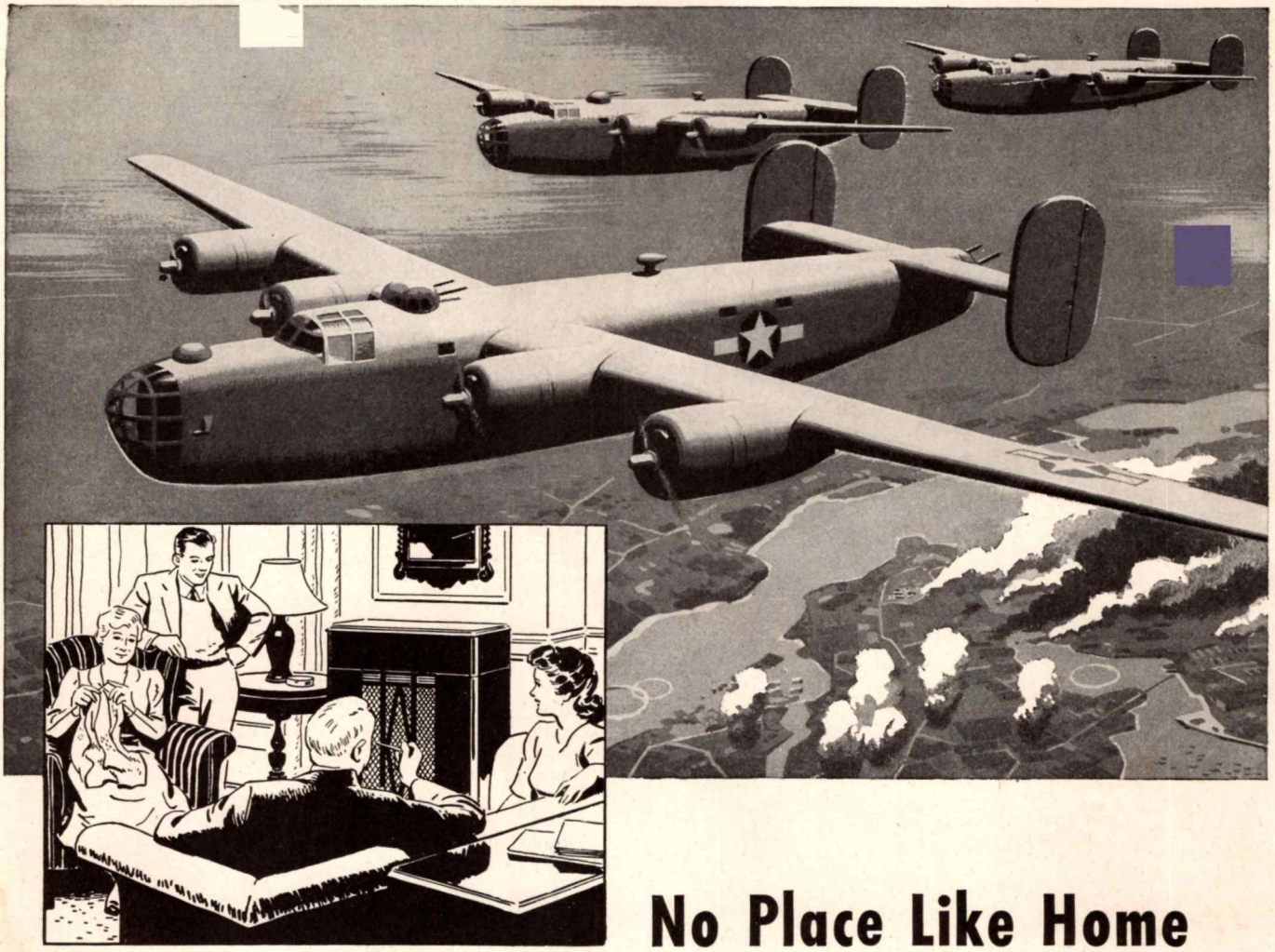


STANDARD & SPECIAL TYPES OF TURNBUCKLES

The manufacture of AN and AC Specification Turnbuckles for aircraft applications is a relatively small, but nevertheless important, part of Air Associates production . . . During the past ten years, many millions of these accurately machined assemblies, in all standard types and many special types, have been supplied to the Army, Navy and leading manufacturers of airplanes. All Air Associates Turnbuckles are made of finest materials and workmanship in exact accordance with applicable Army and Navy Standard Sheets. *With present production higher than ever before, substantial quantities of Turnbuckles in process can be applied on new orders.* Inquiries are invited now.

AIR ASSOCIATES, INC.

TETERBORO, N.J. . . . *BRANCHES.* CHICAGO, DALLAS, LOS ANGELES . . . ENGINEERS & MANUFACTURERS OF AIRCRAFT SPECIALTIES . . . SUPPLIERS OF ALL TYPES OF MATERIALS TO THE INDUSTRY SINCE 1927



No Place Like Home

Compared with the typical home radio set—protectively nestled in a quiet living room—the electronic devices on a bomber lead a dog's life. Their delicate parts are subjected to the jarring concussion of exploding flak—the "kick-back" of bursting block-busters—the vibration of roaring motors and firing guns . . . a mauling severe for even the most rugged parts.

How these sensitive instruments are able to hold up under such bruising punishment is a story that dates back to the early days of automotive radio. Technicians of Delco Radio faced parallel problems—vibration, electrical interference, temperature and humidity extremes, bumping and jarring. They faced a set of conditions totally new and different in the radio field—the special conditions attending "radio in transit."

One by one, these problems fell before the forces of research, experiment, ceaseless testing and trying. Automotive radio became a practical, workable reality. And with success in this endeavor came a fund of special experience, off-the-trail knowledge, that has come in mighty handy in World War II. For Delco Radio engineers have applied their experience in automotive radio to the task of giving the forces of freedom—on land, at sea, in the air—a strong, clear voice. Delco Radio Division, General Motors Corporation, Kokomo, Indiana.

Back Our Boys By Buying Bonds!

Delco Radio
DIVISION OF
GENERAL MOTORS

CHAMPION SPARK PLUGS

are rapidly gaining favor in all branches of aviation due to certain inherent superiorities in performance and dependability, directly traceable to their specially developed ceramic insulation.

C26S—Shielded

C26—Unshielded

Champion Ceramic Aircraft Spark Plugs, like all Champions, have a reputation for making every engine a better performing engine.

For the most advanced, high output, turbo supercharged, high altitude engines or low output engines for "grasshoppers" Champion Spark Plugs are available in types and sizes specially qualified to give maximum performance and dependability.

The same special ceramic insulation is used in all Champion aircraft spark plugs. It has the following exclusive characteristics in service and largely accounts for their superior performance.

1. Immunity from heat and chemical reactions.
2. Freedom from fuel, oil or moisture absorption which causes "shorts."
3. Inherently high heat conductivity with consequent wider range between pre-ignition and fouling.
4. Absolute uniformity of material.
5. Homogeneous structure eliminates air spaces which cause current leakage.
6. Easily cleaned and serviced—no specialized equipment or factory returns necessary.
7. Scientifically controlled manufacture.

KEEP 'EM FLYING ARMY E NAVY **BUY WAR BONDS AND STAMPS**

In at the finish — "MX" WHEELS

. . . AND IT'S THE FINISH THAT'S IMPORTANT!

IN at the finish of innumerable industrial operations these days is the versatile "MX" Wheel, introduced by Carborundum, only a little over a year ago. Their function is to remove "disturbed metal" such as the burrs and tool marks which result from grinding, machining, boring and similar operations.

"MX" Wheels are made up of abrasive grains intermingled with cotton fibres and held together with a suitable binder. They are unlike any other abrasive product made. They are free and clean cutting and are used without coolant. They are resilient and have a cushioning effect which makes them tend to hug the work. Chatter and vibration are reduced. The result is a smooth finish so important in current manufacturing methods.

"MX" Wheels are ideal for breaking corners, removing burrs and polishing grooves and slots. Surrounding surfaces are kept free of abrasive marks. Tolerances are maintained in polishing because of the light stock removal.

Write to Dept. *AD*, The Carborundum Company, Niagara Falls, N. Y. for literature describing "MX" Wheels and their many uses.

Every hour this war is shortened will save $12,000,000. The lives it will save are priceless. Let's get it over with—quickly!

ARMY E NAVY

CARBORUNDUM
REG. U. S. PAT. OFF.
ABRASIVE BRAND PRODUCTS

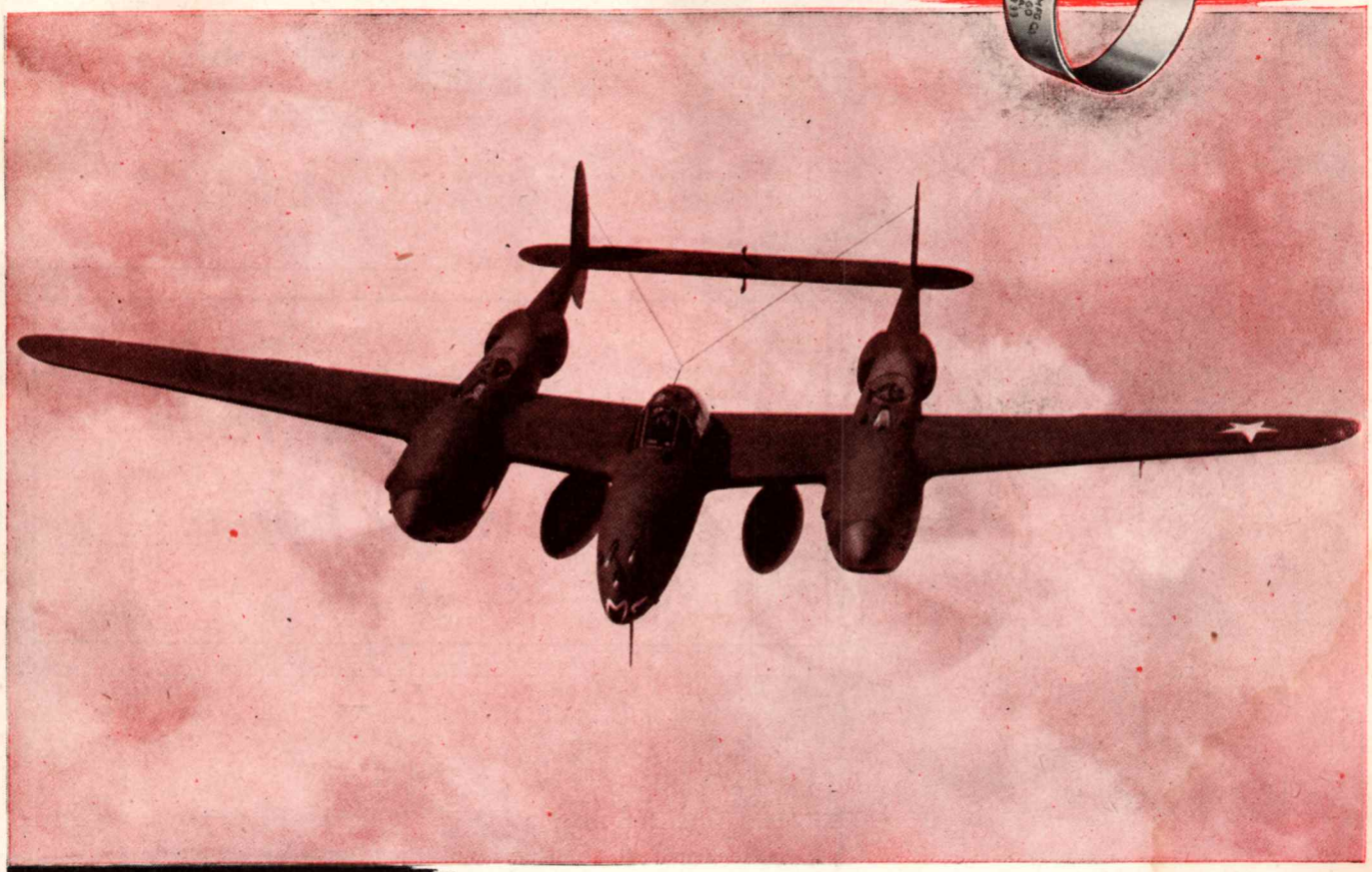
THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.
REG. U. S. PAT. OFF.

MANUFACTURERS OF GRINDING WHEELS, COATED ABRASIVES, SUPER REFRACTORIES, HEATING ELEMENTS

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

(Carborundum and MX are registered trade-marks of and indicate manufacture by The Carborundum Company)

Amazing Performance at Extremely High Altitudes



LOCKHEED P-38 LIGHTNING *is equipped with* WITTEK *AVIATION* HOSE CLAMPS

Flying faster, higher and farther than any enemy fighter . . . taking punishment, yet still delivering the goods—the Lockheed P-38 Lightning is equipped with Wittek Aviation Hose Clamps. Today, as in the past, Wittek Aviation Hose Clamps, known as the standard of the industry, are being used by the nation's leading military aircraft and engine builders. Wittek Manufacturing Co., 4305-15 West 24th Place, Chicago 23, Ill.

ARMY E NAVY

WITTEK *Aviation* **HOSE CLAMPS**

...BUY MORE WAR BONDS...

No wonder he rode a brewery horse

WHEN the iron man of old rode forth to battle, he jogged along at a pretty conservative gait. What with his hand-wrought and riveted riding habit, chain-mail underwear, broadsword, lance, et al, his steed had to be built for heavy-duty rather than speed.

That was the price he paid for protection. Perhaps it wasn't too high then, but it would be today. Our modern "cavalry of the air" has the superlative protection of Hycar synthetic rubber in bullet-sealing tanks and hose, in hydraulic seals and diaphragms. At the same time Hycar is light—saves 20% to 25% in weight over many other synthetics, and its resistance to oil-absorption keeps it light. Speed, range and payload are the beneficiaries.

Aren't these the qualities you have wanted in oil and fuel hose, hydraulic lines, seals, gaskets, grommets, diaphragms and other resilient products you use? *Hycar Chemical Company, Akron 8, Ohio.*

Hycar

LARGEST PRIVATE PRODUCER OF BUTADIENE

Synthetic Rubber

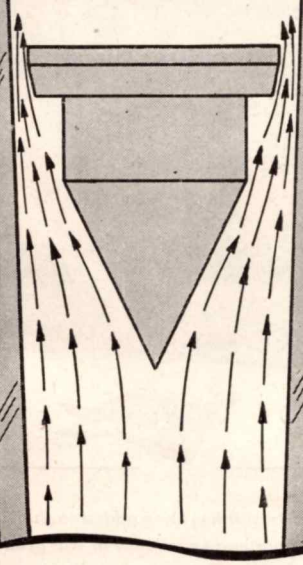
***LIMITED QUANTITIES OF HYCAR** are now available to your rubber products supplier for experimental purposes without WPB allocations. This material may be used in the development and test of products for both present and future manufacture. It enables you now to gain actual experience with Hycar in many applications heretofore not permitted under war restrictions, but which may be vitally important to your post-war plans. Our technical staff and laboratory are ready to help.*

The ROTAMETER

—its basic advantages over head-type meters

8 BASIC ADVANTAGES

1. Metering elements and fluid being metered clearly visible
2. Wide flow range—20-to-1 easily obtained
3. Evenly spaced scale divisions—no compression of scale at low flows
4. Low, constant pressure drop—reduces pumping costs
5. New Stabl-Vis rotameter compensates for viscosity and density variations
6. 10″ to 24″ travel of metering float—accuracies correspondingly high
7. Instantaneous response to flow change—no friction or hysterisis
8. Measures corrosive gases, liquids and slurries that no other meter will handle accurately



E-V-E-N-L-Y spaced scale divisions

The big advantage of the linear calibration of the rotameter is apparent when you are operating in the lower portion of its range. The scale divisions at low flows are just as far apart as at high flows. Low flow rates may therefore be set or read with the same high accuracy. This feature of the Rotameter, which makes it of such great help in controlling process flows closely, can be scientifically explained as follows:—

In Toricelli's fundamental flow equation, $Q=CA\sqrt{2gh}$, the area-type meter (rotameter) measures by varying the value of "A" (area of flow passage) whereas head-type meters (fixed orifices) vary the value of "h" (head). Thus, the rotameter "gets out from under the square root sign" which results in a linear calibration scale, instead of a square root scale with crowded divisions at the lower end. Consequently with the rotameter the same high accuracy of reading or of setting the flow rate may be obtained over the entire flow range.

The rotameter's straight line calibration curve is but one of its many advantages as a flow rate instrument. These advantages are rapidly causing instrument and operating engineers to replace fixed orifice meters by the rotameter in many important metering applications. The full details are told in a comprehensive and highly interesting booklet just printed, entitled "A New Era in Flow Rate Measurement." Large illustrations and a modern cartoon style make it easy and instructive reading. We will gladly send you this pamphlet without obligation—write us if you wish a free copy.

FISCHER & PORTER PRODUCT INFORMATION

Aviation's latest sensational flight instrument—

The MAGNA-BOND
Remote-reading fuel flow meter!

A remote-reading fuel flow meter for bombers that weighs only 4 pounds and that compensates automatically for *viscosity* and *density* changes in the fuel being metered. Such is aviation's latest remarkable instrument for long-distance flying efficiency. So new that bulletins are not yet off the press—but write and we will send you full information.

You will be able to see our latest developments at BOOTH 304-306—CHEM. SHOW, NEW YORK—DEC. 6 to 11.

FISCHER & PORTER CO.

2011 COUNTY LINE ROAD, HATBORO, PA.

RATE OF FLOW INDICATING, RECORDING OR CONTROLLING ROTAMETERS FOR ANY LIQUID OR GAS

This New Publication tells how to *Choose and Use*

TAFT-PEIRCE THREAD SNAP GAGES

Here, in one brief and easy-to-read bulletin, are set forth the advantages of both types of thread snap gages:

ADJUSTABLE Thread Snap Gages of the rectangular crowned-anvil type originated by Taft-Peirce . . . with the exclusive advantage of a true form of thread ground into the anvil face.

ROLL Thread Snap Gages now made by Taft-Peirce under the John-Sons patents, with either open or closed faces . . . with gaging rolls of several lengths, and for any pitch and diameter.

Adherents of each type of thread snap gage will find in this new bulletin all of the information necessary to enable them to order the right gages for their work . . . plus helpful instructions on how to get the best results in gaging, and how to keep their gages in serviceable condition. For *your* copy of the Taft-Peirce Thread Snap Gage Bulletin, write a note on your letterhead today.

ARMY E NAVY

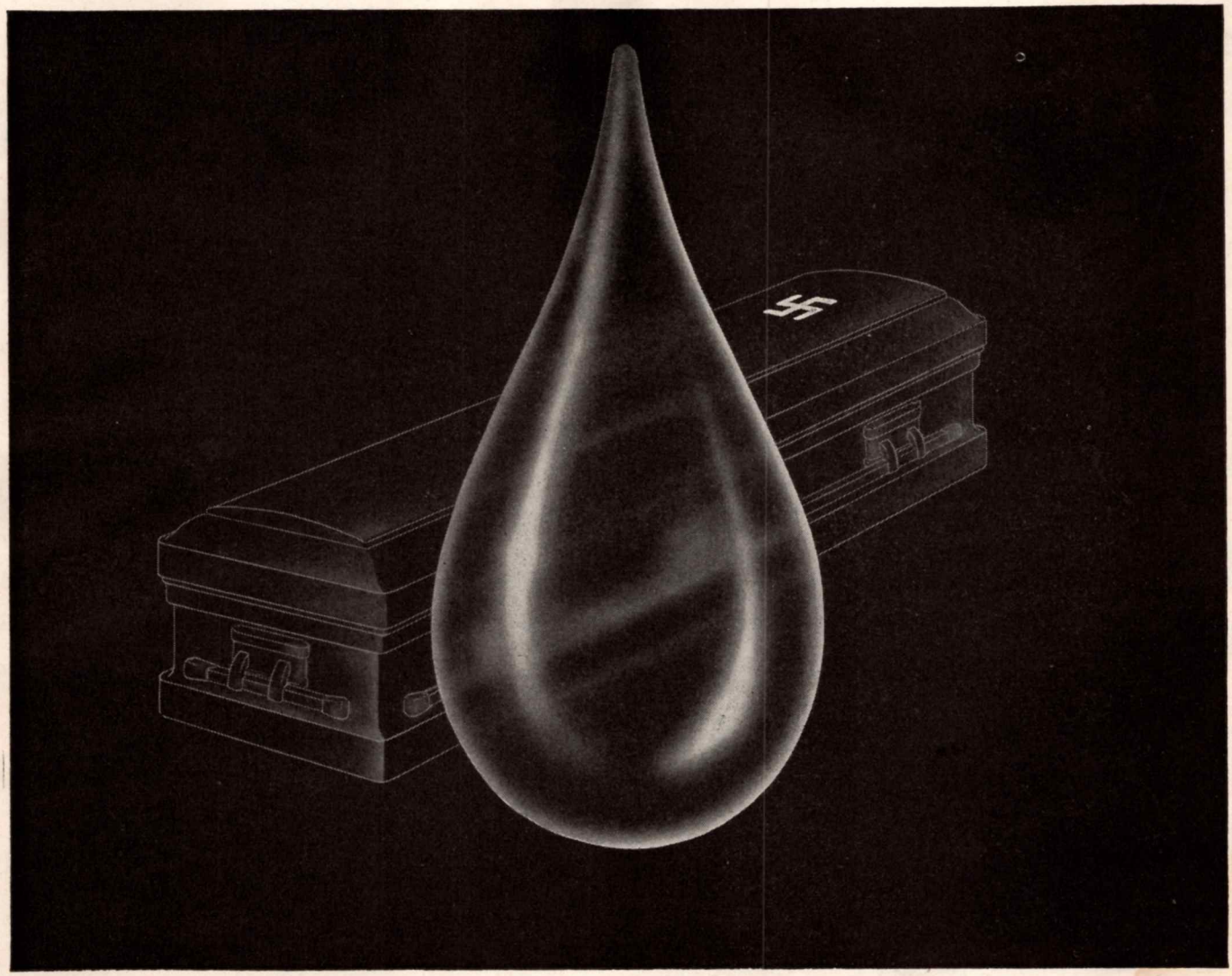
The first star has been added to the T-P flag for continued Excellence in war production

THE

TAFT-PEIRCE

MANUFACTURING COMPANY

Woonsocket, Rhode Island



LAST NAIL IN THE AXIS COFFIN

IF YOU want to know what catalytically cracked aviation fuel has meant to America's war effort, we suggest you read "Fightin' Oil," by Petroleum Administrator Harold L. Ickes. In this highly informative and to-the-point volume, he says:

"When I said that even 100-octane gasoline is beginning to be a little old-fashioned, I was probably thinking more particularly of the catalytic cracking plants that are now opening up in many parts of the country with startling regularity. They come close, in my opinion, to being the last nail in the coffin of the Axis. The new superfuel that they produce has quality factors which make it even better than the 100-octane of a year ago, and the use of it gives the American-made plane the advantage of greatly superior speed and maneuverability. Fueled with it, one of our bombers can carry a 25 per cent greater bomb load. In other words, on a long-range offensive to the Axis capitals, 1,000 American-made four-engine bombers with an aggregate bomb capacity of 8,000,000 pounds would be able to transport 2,000,000 more pounds of explosives on every visit than if fueled with yesterday's 100-octane gasoline. A two-engine bomber with a 4,000-pound bomb capacity can carry another 1,000 pounds. And that, as someone has observed, 'ain't feathers'."

When Mr. Ickes' book was published in June this year, 17 out of 20 (now it's 20 out of 24) catalytic cracking units in operation were Houdry units. They had produced more than 90% of *all* catalytically cracked aviation fuel for the United Nations.

HOUDRY CATALYTIC PROCESSES
... FOR VICTORY IN WAR
... FOR PROGRESS IN PEACE

HOUDRY PROCESS CORPORATION, WILMINGTON, DELAWARE

Houdry Catalytic Processes and the Thermofor Catalytic Cracking Process are available through the following licensing agents to all American refiners, subject to approval by the U. S. Government.

E. B. BADGER & SONS CO.
Boston, Massachusetts

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BECHTEL-McCONE-PARSONS CORP.
Los Angeles, California

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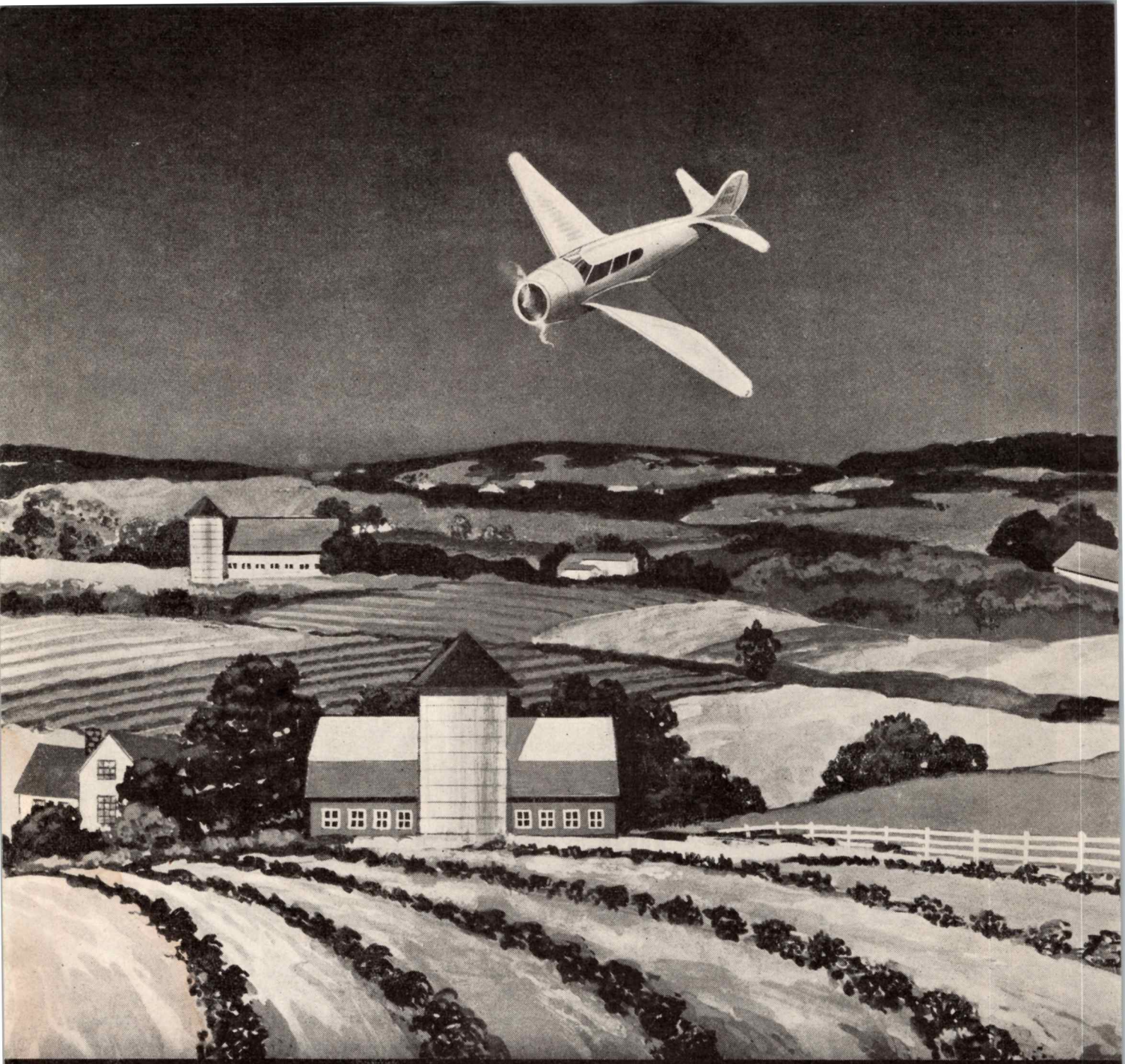
THE LUMMUS COMPANY
New York City, New York



HOME *Straight as an Arrow...*

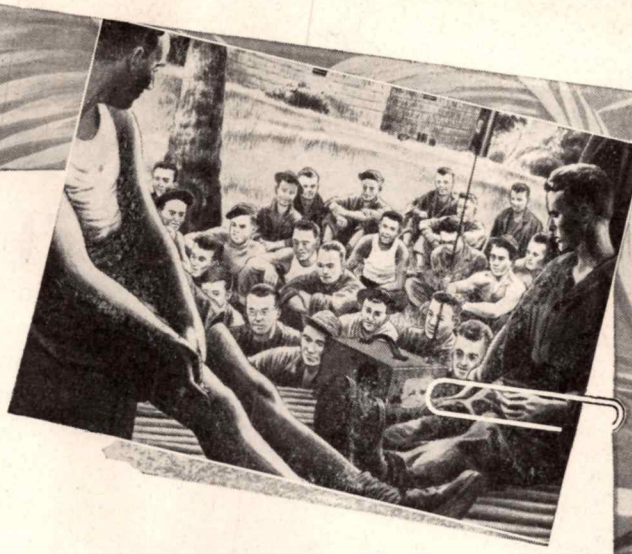
With the unconditional surrender of our enemies,—which must be won by our blood, sweat and toil—, will come peace and the post-war period of reconstruction and development.

Aviation, now the No. 1 industry of America, will continue to lead the way. From the centers of our great cities to the vast expanses of our rural sections, Airplanes will play a leading part in our lives. Distances between home and place of business will be of much less importance, as the speed and efficiency of Aircraft will make commuting practical and economical. You can go home straight as an arrow, from wherever you are.

Advanced engineering and foresight will continue Jacobs leadership in the production of dependable and economical Aircraft Engines — ***practical engines*** for the private owner, the business concern and the "feeder" Airline.

JACOBS AIRCRAFT *Engines*

POTTSTOWN · PENNSYLVANIA U·S·A·



Australia
June 18, 1943

Hallicrafters
Chicago, Illinois
U.S.A.

Dear Sirs:

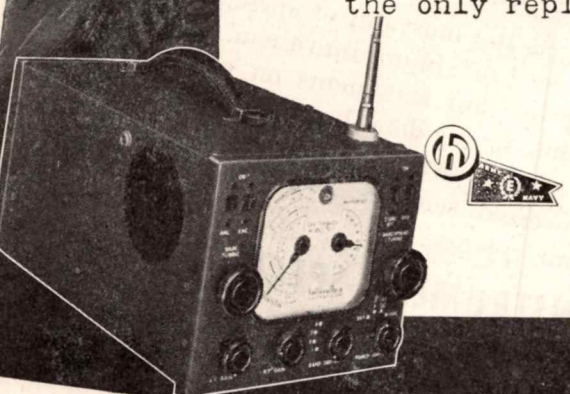
In the May issue of QST, appeared a picture of your Hallicrafters Model S-29 Radio...and a group of men and myself listening in on a program...in the New Guinea area.

The Radio which appears in this picture was purchased by myself in August, 1941. This same radio has been in continuous operation...and has caused no trouble.

This Hallicrafters Model S-29 was one piece of equipment which every man...was anxious to carry. It was carried at all times...through New Guinea jungles...in the midst of a jungle swamp ...where tropical rains fell heavily...in extreme damp heat, this radio never once faltered. It brought untold relief to every fighting man... caused tense nerves to become relaxed, bringing happy moments to dark surroundings. The part played by this instrument could never otherwise be duplicated. Every night...the fellows would listen to the news from home. Notes were taken ...and news was called to the troops on front line duty. Without this radio there would have been no contact with the outside world.

This same radio is operating perfectly and the only replacement needed was a new set of **tubes.**

Sincerely yours,
Glen V. Blakeslee
Glen V. Blakeslee



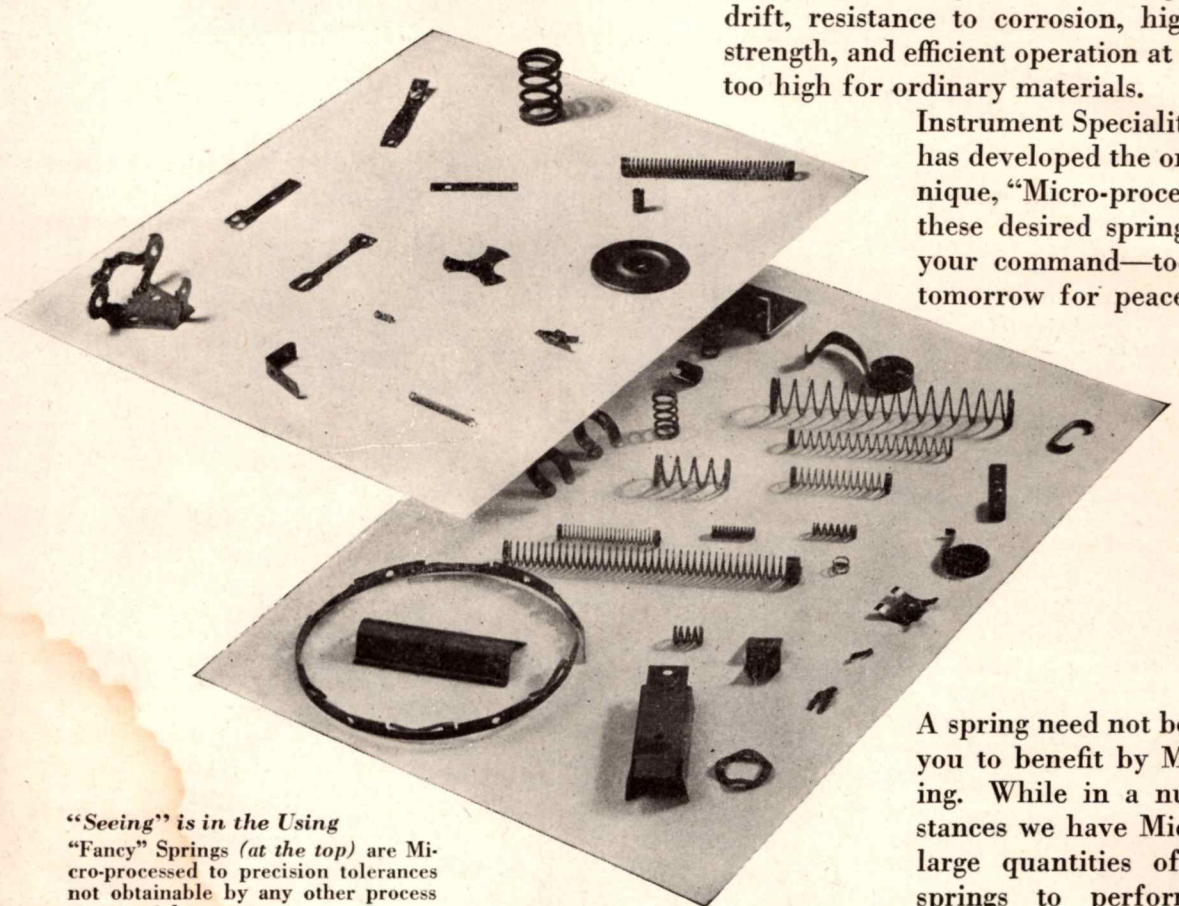
BUY MORE BONDS!

the hallicrafters co.
CHICAGO, U.S.A.
WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT

We expect you to expect more of your SPRINGS

The tough spring jobs go to beryllium copper in this war, for of all spring materials, this metal offers the best combination of all critical spring requirements—maximum electrical conductivity with high tensile strength, minimum drift, resistance to corrosion, high endurance strength, and efficient operation at temperatures too high for ordinary materials.

Instrument Specialities Company has developed the one exact technique, "Micro-processing," to put these desired spring qualities at your command—today for war, tomorrow for peace.



"Seeing" is in the Using

"Fancy" Springs *(at the top)* are Micro-processed to precision tolerances not obtainable by any other process or material.

For "Average" Springs *(below)* Micro-processing delivers closer tolerances and better physical properties than obtainable by ordinary processing methods.

A spring need not be "fancy" for you to benefit by Micro-processing. While in a number of instances we have Micro-processed large quantities of exceptional springs to perform functions never before expected of any springs; in hundreds of other cases we have added materially to the life of such every day products as brushes, motors, instruments, etc., by improving the quality of "average" springs.

I-S gets the most out of springs by putting the required maximum into them. We stand ready to prove our statements on your own springs. A time-saving data sheet is available on request, or send drawings and specifications for Micro-processed samples. Why not expect more of your springs?

INSTRUMENT SPECIALTIES CO., INC.

DEPT. M, LITTLE FALLS., NEW JERSEY

"MICRO PROCESSED" I-S BERYLLIUM COPPER SPRINGS

The Birdmen's Perch

Here we are in trouble again!

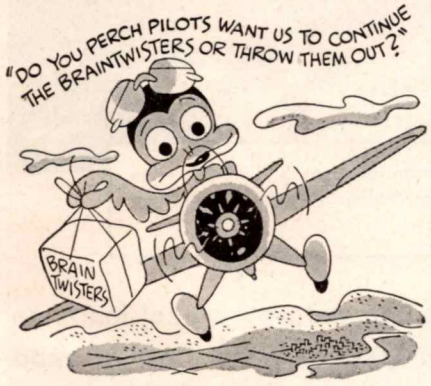
It started when we gave our typewriter to the Government (one of the big ones they needed) and got a dinky little machine of JN-4 vintage.

Our old typewriter was a wonderful machine. It wrote the Perch, answered our mail, checked Braintwister answers, cleaned the office at night. All we ever did for it was change its Gulfpride periodically. (Yes, of *course* it had a crankcase!)

But the new (?) one falls off into a flat spin every time we rev it up. In August, it credited J. B. Cunningham of Reno, Nev., for a Braintwister which was *really* by Donald Peer of Reno (he's a Ground Instructor).

What's more, it didn't check the answer to Peer's Braintwister. If it had, it would have discovered a mistake . . . not in the answer itself, but in the way it was worked out.

So for the benefit of you Untwisters who found our answer even harder



to solve than the puzzle, the next to the last line should have read:

15 equals $\frac{a}{2}-\frac{1}{2}$ instead of 15 equals $\frac{a}{15}-\frac{1}{2}$

And as soon as we finish this Perch, we're going to beat this over-age typewriter to shreds with a baseball bat, and get out of town until the whole mess blows over. Anyhow, the steel mills need more scrap metal . . .

Major Al Williams,
alias, "Tattered Wing Tips,"
Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

FROM A CAA POWER-PLANT MANUAL—

"SLUDGE . . . is the gumlike substance formed by the cracking and partial oxi-

dation of the oil molecules . . . tends to clog oil filters and passages has caused engine stoppage, forced landings.

"CARBON . . . restricts operation of the rings . . . results in failure of piston parts due to overheating . . . in reduced compression, increased oil consumption . . . causes preignition, severe detonation."

That's why we stress that the Alchlor Process (Gulfpride's *extra* refining step)

takes out *more* of the molecules that form sludge and carbon. That's why Gulfpride gives an *extra* film of protection under *more* severe operating conditions.

BRAINTWISTER (GULP!)

Between missions, a bomber crew tried to devise a plan to completely destroy Tokyo with almost no risk to the USAAF.

They decided it could be done in *30 days by one plane!* . . . provided that the plane made a raid every day *with a doubled load of incendiaries on each trip.* The first day the plane would drop one bomb; the second day 2 bombs; the third day 4 bombs; the fourth day 8 bombs, and so on until (they were sure) the city was eradicated on the 30th day.

Can you guess how many days it would take to accomplish this happy task if they started with 2 bombs instead of 1? Write for the answer.

CONTINUED FROM LAST MONTH—

As we were saying Gulf's petroleum background goes a lot further than just engine and lubricating oils . . .

Did you know that oil is the base of insecticides that protect our fighters from

insects more dangerous (and far more numerous) than bullets? . . .

Did you know that oil is used to treat wool fibers used in the uniforms, blankets, and caps for our fighters?

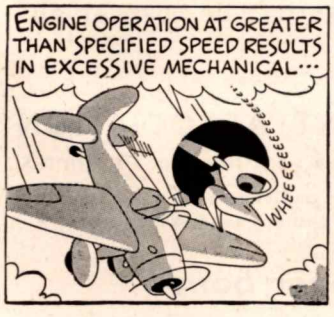
Did you know that petroleum products waterproof the barracks they live in? . . . the raincoats they wear? . . .

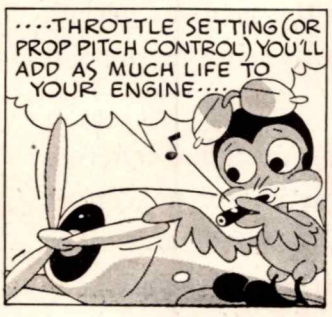
Well, they *do!*

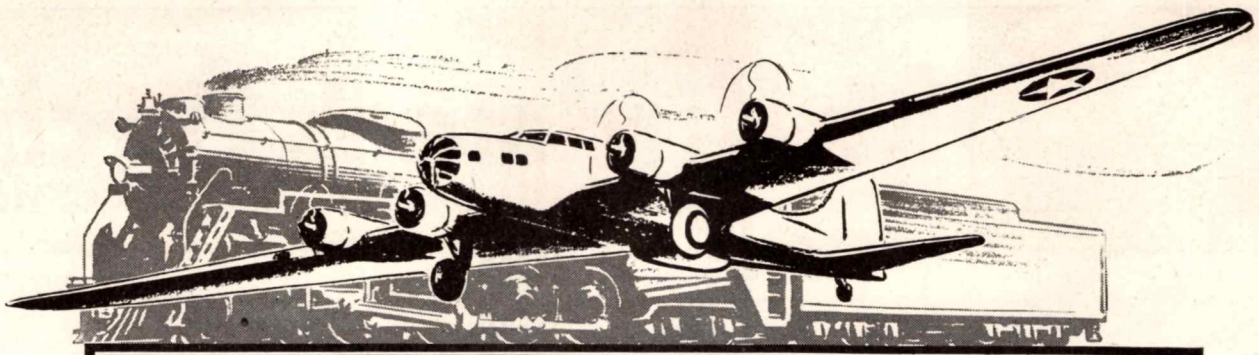
Gulf Oil Corporation and Gulf Refining Company...makers of

GULF AVIATION PRODUCTS

OIL IS AMMUNITION—USE IT WISELY

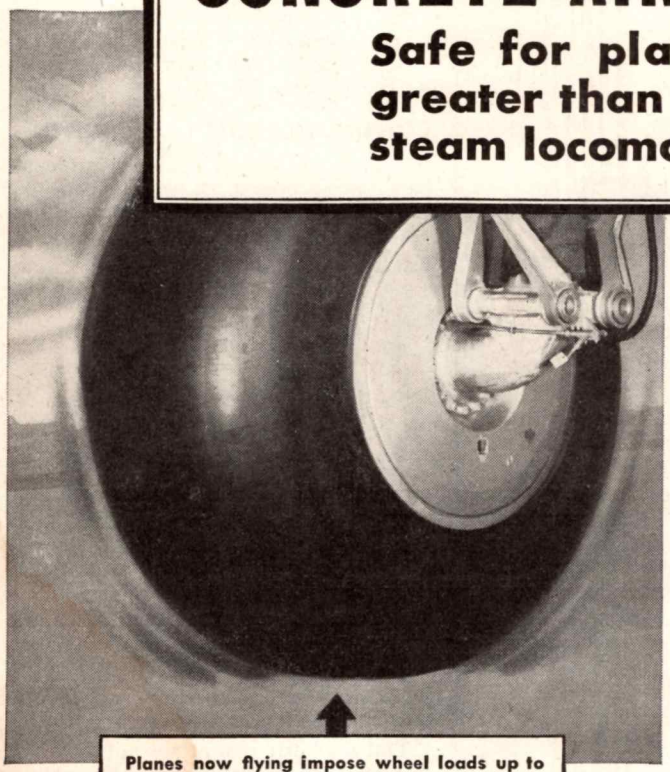




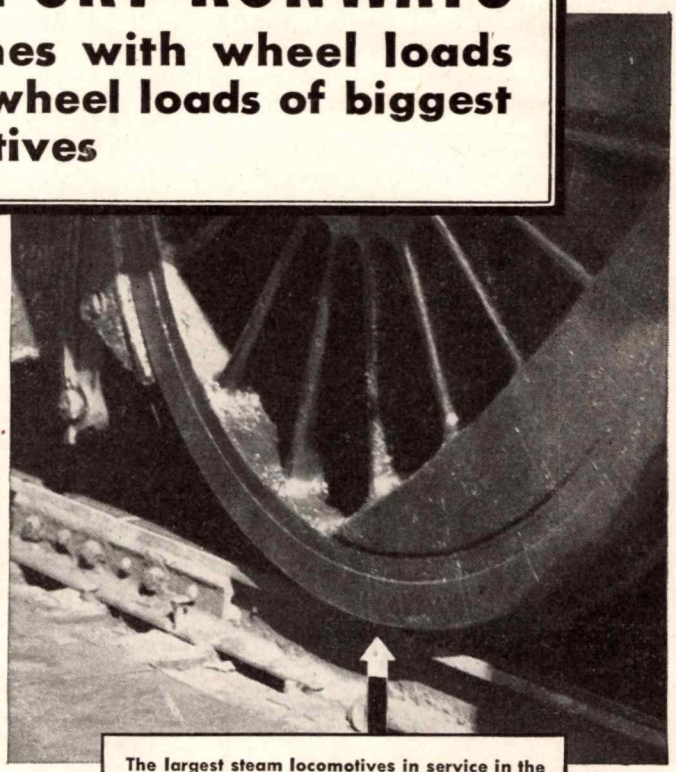


CONCRETE AIRPORT RUNWAYS

Safe for planes with wheel loads greater than wheel loads of biggest steam locomotives



Planes now flying impose wheel loads up to 80,000 lb. It is reported that even heavier planes are being designed. *(Douglas Aircraft Photo)*



The largest steam locomotives in service in the United States have wheel loads of not more than 37,500 lbs.

Heavy wheel loads test the stamina of airport runways or railway roadbeds. And the wheel load imposed by the large modern bombers and transports is even greater than the wheel load of the largest steam locomotives.

For heavy duty airport runways whose use is expected to extend into the postwar period, safety, economic and engineering facts point to concrete.

The first cost of adequately designed concrete runways for heavy duty wartime or peacetime service is usually less than that of any other pavement of equal load-carrying capacity.

Engineering design data for wheel loads up to and beyond 150,000 lb. show how to build concrete runways of unquestioned stamina without wasteful overdesign or danger of early failure under heavy traffic.

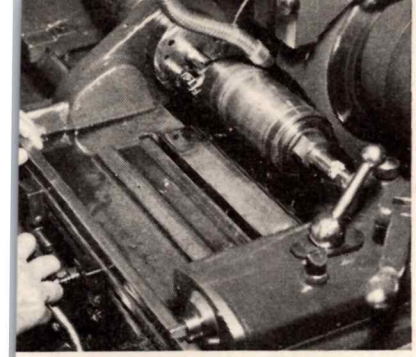
Our experienced engineers are ready to assist in the design of concrete war or postwar airport pavements.

PORTLAND CEMENT ASSOCIATION

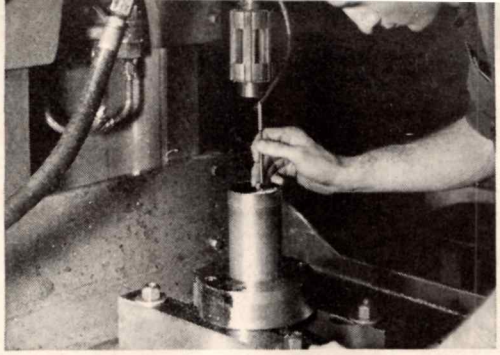
Dept. A11-33, 33 W. Grand Ave., Chicago 10, Illinois

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

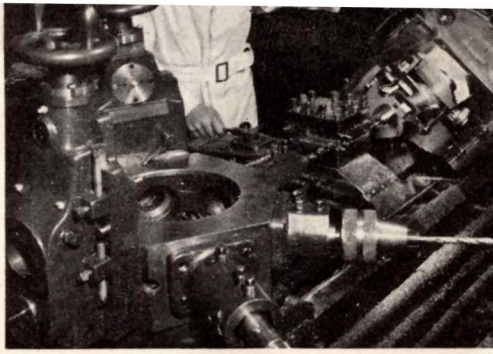
Buy more war bonds



on cylinders and other parts are precision assuring absolute accuracy and uniformity.



Wear and leakage are greatly reduced by honing interior of hydraulic cylinder to mirror smoothness.

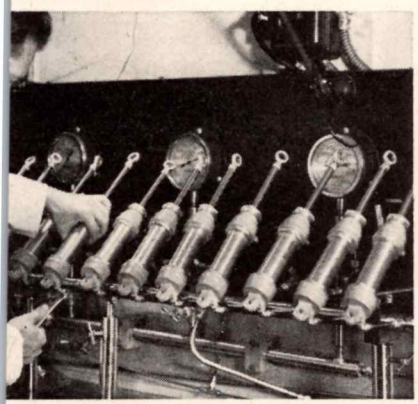


Turret lathes complete various operations in sequence to insure absolute uniformity.

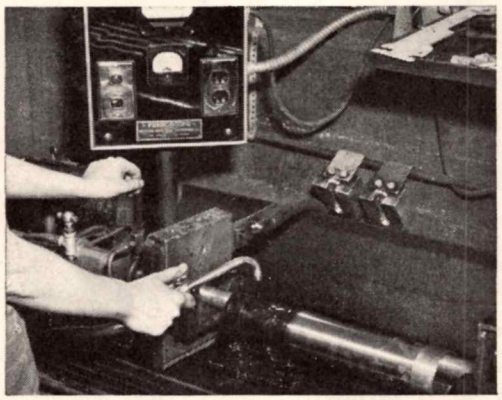
Interstate

— ANOTHER NAME FOR PRECISION

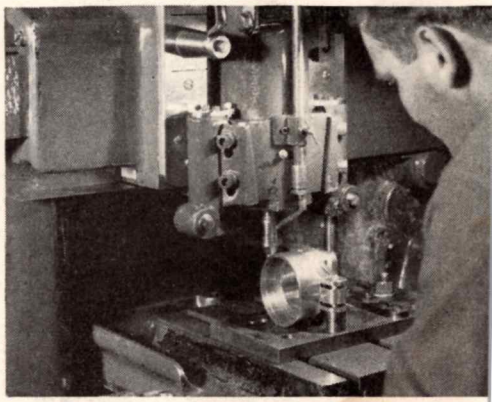
INTERSTATE AIRCRAFT AND ENGINEERING CORPORATION • EL SEGUNDO, CALIFORNIA



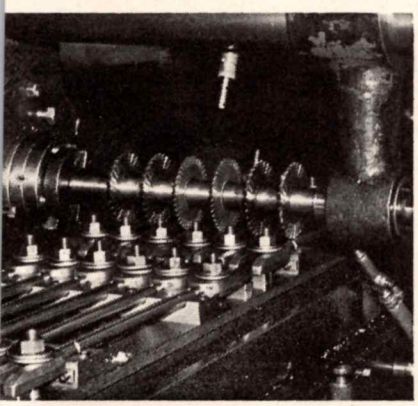
ultiple tester saves valuable time in testing lic cylinders and increases overall efficiency.



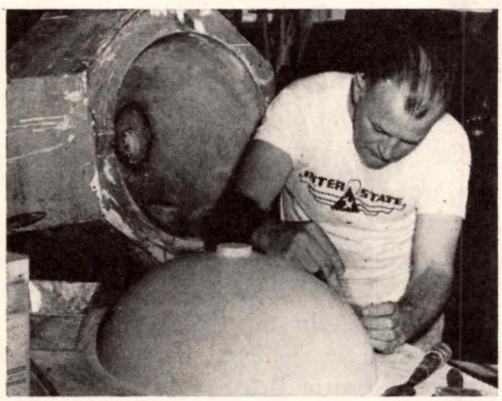
The danger of hidden imperfections is avoided by the magnetic testing of materials in inspection.



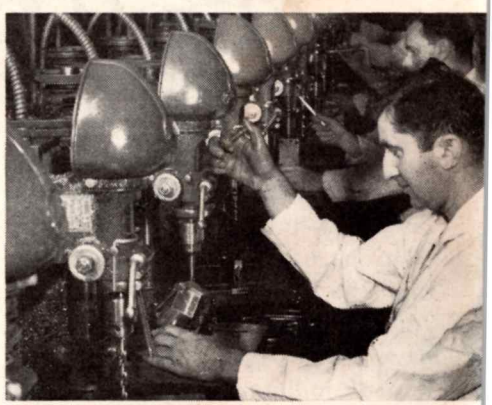
Perfect alignment is obtained in this drilling operation by tooling with greatest accuracy.



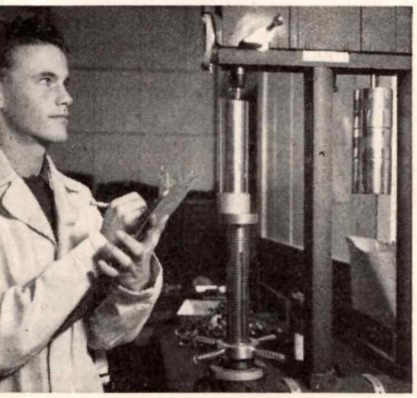
ine operations are conducted in multiple ver possible to conserve time and cut costs.



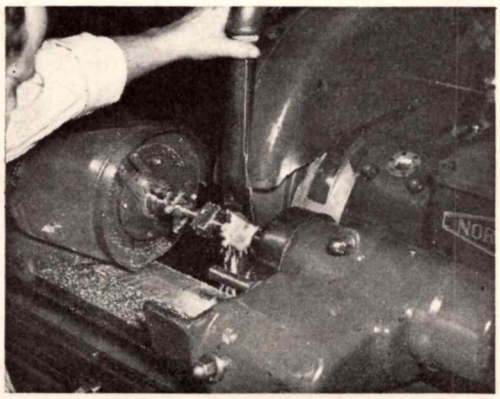
Jigs and dies are precision-built to obtain utmost accuracy in machined parts for finished production.



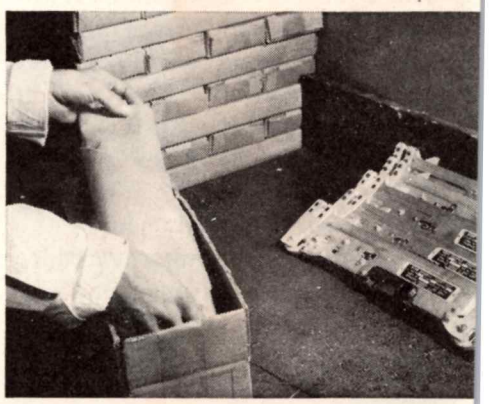
Rows of drill presses provide for rapid production by standardizing operations in correct sequence.



part that goes into a complete assembly is ghly checked and inspected for hardness.

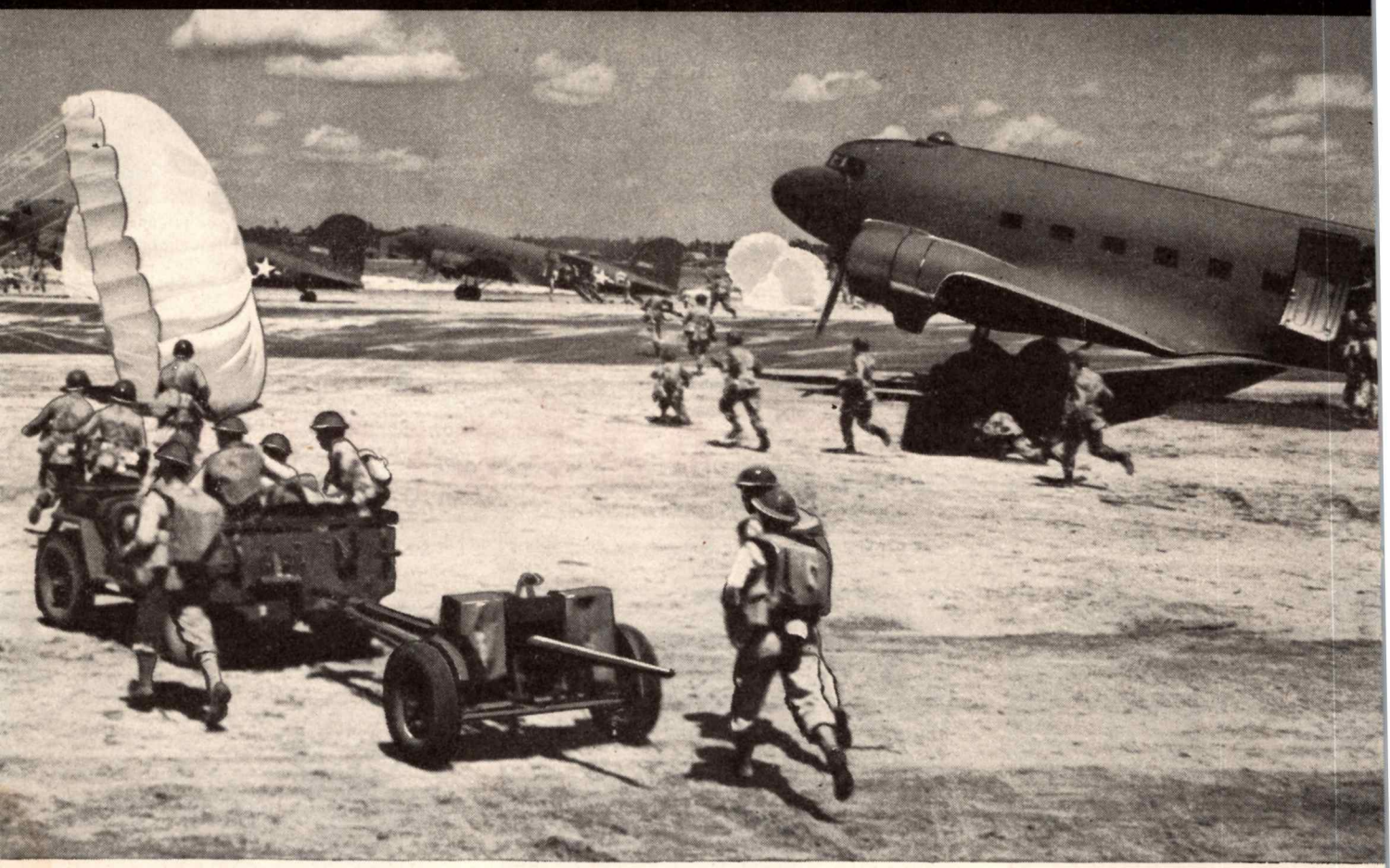


Parts are ground to close tolerances on precision grinders for faultless performance.



Mechanisms are wrapped and cartoned for protection against damage and corrosion.

"Greatest Piece of Transportation in This War"



*The Home Front**

By TOM TREANOR

. . . The greatest piece of transportation in this war is the Douglas DC-3 transport plane . . . (which) has won more battles than the jeep.

. . . without the DC-3 there would never have been the weblike system of military airlines all over the world . . . now known as the Air Transport Command. Without the DC-3 the Air Transport Command would have been set back a good year.

And without the Air Transport Command there's many a battle in this war would have gone slower or even completely sour.

To give one example, ever since the fall of the Burma Road the Chinese war has been supplied almost entirely by the DC-3.

Don Whitehead of the Associated Press tells me that during the Tunisian campaign 15,000 casualties were evacuated in DC-3's without the loss of a plane or a life.

A surgeon told him that a principal reason for the extremely low American battle death rate was the rapidity with which the wounded could be brought to fully equipped hospitals by plane.

During the western desert campaign Whitehead says that without the supplies which were ferried to the front by DC-3's the 8th Army's advance would have been slower and the Africa Korps could have dug itself in for determined stands instead of being nearly routed.

"We'd often see them coming over the desert in formation," he said, "flying so low they seemed no more than five feet above the ground, rising and falling with each ridge. Sometimes they'd come into advance airports while the dust of enemy bombings still hung in the air."

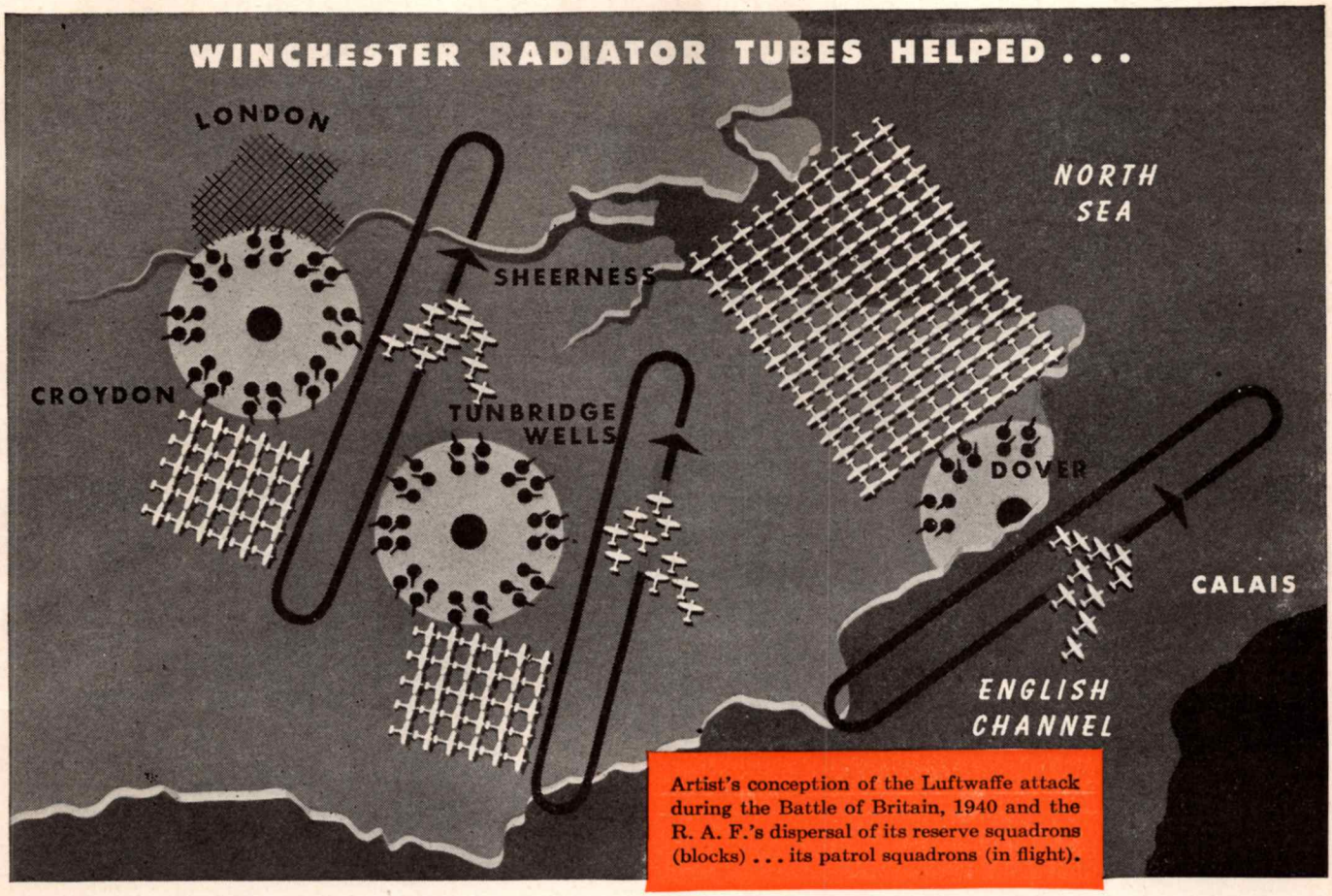
*"The Home Front" is a daily feature in the Los Angeles Times. The foregoing are excerpts from this column which appeared Sept. 6, 1943. Tom Treanor is literally a "self-made" war correspondent whose colorful exploits on many fronts have won him acclaim. Reference to the DC-3 also applies to the C-47 Skytrain and C-53 Skytrooper, basically identical models. This material is reprinted with the appreciation of the men and women of Douglas who build the planes Treanor praises.

DOUGLAS *Aircraft Co., Inc.*

Santa Monica, Calif.

LONG BEACH, EL SEGUNDO, AND DAGGETT, CALIF., TULSA, OKLAHOMA, OKLAHOMA CITY, CHICAGO

Member, Aircraft War Production Council, Inc.



Artist's conception of the Luftwaffe attack during the Battle of Britain, 1940 and the R. A. F.'s dispersal of its reserve squadrons (blocks) . . . its patrol squadrons (in flight).

"SPITFIRES" AND "HURRICANES" CLEAR THE SKIES OVER BRITAIN IN 1940

The Battle of Britain is enshrined in Churchill's immortal words, "never in the field of human conflict was so much owed by so many to so few."

To have been a part of that heroic defense is an honor of which Winchester is justly proud. In 1938, Winchester engineers took to England the designs and machinery for setting up a plant to make Winchester Cartridge Core Radiator Tubes . . . and from then on, most British planes have been equipped with radiator tubes from this plant.

Made of pure copper, with walls only 6/1000ths of an inch thick, Winchester Radiator Tubes, thanks to Winchester's COLD copper-extrusion process, are seamless and so assembled that *their entire outer surface is cooling area.*

WINCHESTER RADIATOR TUBES RESIST CORROSION . . . DEFY BURSTING. Pure copper, Winchester Cartridge Core Tubes will not corrode under regular operating conditions. And they won't burst from freezing, because the coolant flows on the *outside* of the tubes. If freezing should compress a tube, causing a "set" and so restricting air flow, passing a rod through it restores it to normal shape.

IF WOUNDED THEY QUICKLY FLY AGAIN. Pictures below show how to replace Winchester Cartridge Core Tubes should they be punctured in action or by accident. They explain, too, why millions of Winchester Cartridge Core Tubes are used to keep planes, and tanks in constant action.

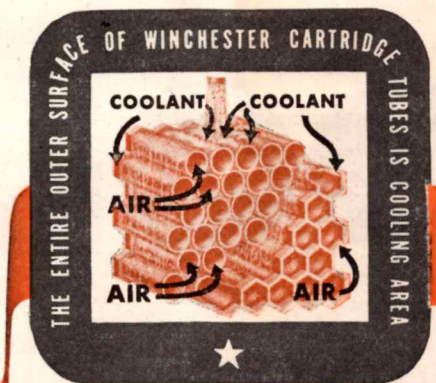
HARDER JOBS WANTED FOR THESE SENSATIONAL TUBES

No War Baby, Winchester Cartridge Core Tubes have 25 years of service behind their performance. They offer these spectacular features:

- Of pure copper, thus corrosion-proof.
- Seamless,—safe against leaks.
- Coolant on *outside*—no damage from freezing.
- 1,728 cartridge core tubes per square foot.
- Avoid waste space in radiator assembly—minimum of solder.
- Permit tailoring radiator, to fit any dimension or design.
- Provide up to 25% greater cooling per square foot than others.

WINCHESTER REPEATING ARMS COMPANY
New Haven, Connecticut
Division of WESTERN CARTRIDGE COMPANY

WINCHESTER
TRADE MARK
"On Guard for America Since 1866"



Damaged tubes are pushed out. New Tubes are inserted. Soldering completes repair.

If out of your engineering knowledge, experience, research and skill you are contemplating a new fighting machine for Uncle Sam . . . are dreaming up a startling new post-war automobile, or similar product, write Radiator Division, Winchester Repeating Arms Company, New Haven, Connecticut.

COPR., 1943, WINCHESTER REPEATING ARMS CO., DIV. OF WESTERN CARTRIDGE CO.

RIFLES • SHOTGUNS • CARTRIDGES • SHOTSHELLS • CARTRIDGE CORE RADIATOR TUBES • FLASHLIGHTS • BATTERIES

★ The higher—the fewer. And it takes very special equipment to be sure you can get on top—first.

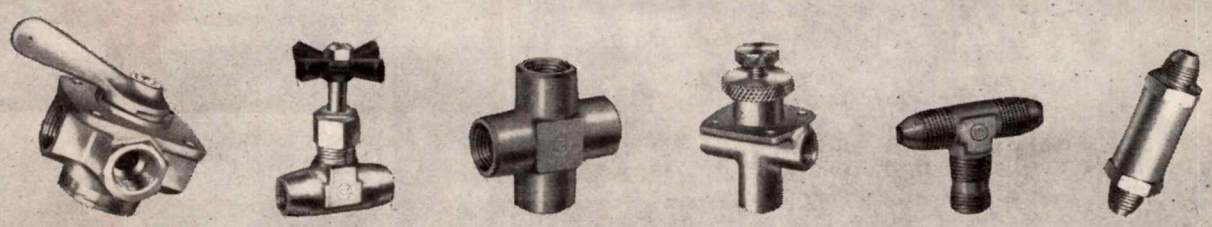
Dole Aircraft Valves and Fittings are precision manufactured and rigidly inspected. Today they are helping U. S. planes fly higher and faster and do a better fighting job.

Tomorrow Dole engineers and production men will offer all this knowledge and experience, plus modern facilities, to help you solve your peace-time problems in aircraft and kindred industries.

Made in accordance with Army and Navy Aeronautical Standards

DOLE

THE DOLE VALVE COMPANY
Established 1906
1901-1941 Carroll Avenue, Chicago 12, Illinois
LOS ANGELES DETROIT PHILADELPHIA



AIRCRAFT VALVES AND FITTINGS

Flexing doesn't weaken AMERFLEX

Reg. U. S. Pat. Off.

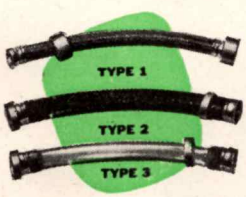
Amerflex plastic-covered conduit assemblies pass the flexing test with flying colors. And here's the reason: the light, tough, abrasion and moisture-resistant synthetic tubing employed in their manufacture is applied cold by a patented Searle process. Once in place, the covering grips the metallic base firmly and evenly. The result—a smooth finish . . . securely seated ferrules . . . closely held o. d. dimensions . . . and a covering that is not weakened by flexing.

Amerflex assemblies are sold under a service plan which 1) prevents waste due to engineering changes; 2) reduces conduit assembly inventories; 3) lowers conduit assembly costs; 4) reduces scrap by eliminating rejects; 5) ends possible conduit bottlenecks.

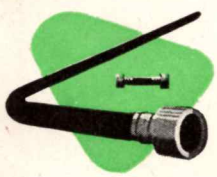
At your request, a representative will be glad to discuss the "Searle Conduit Assembly Service Plan" with you. We also invite you to submit your conduit engineering requirements.

SEARLE AERO INDUSTRIES, INC.

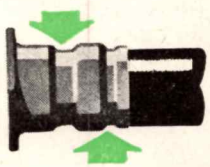
ORANGE, CALIFORNIA



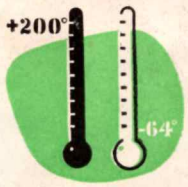
3 Types of Amerflex. *Type* I—plain, uncovered flexible metallic conduit. *Type* II—synthetic-covered flexible metallic conduit. *Type* III—synthetic tubing with fittings, but without metallic conduit.



Assembly Sizes. *Type* I assemblies are made in any length and inside diameters of ⅜" to 2½". *Type* II and III assemblies are made in any length and in inside diameters of ⅜" to 2".



Ferrules. Amerflex ferrules are held in place by two grooves. One provides a moisture-proof seal; the other, channeled firmly into the metal conduit, provides a strong, lasting grip.



Cold, Heat Resistance. Amerflex tubing, opaque, withstands continuous temperatures of 200° F., remains pliable at –40° F. Temperature ranges for transparent tubing go from 188° F to – 64° F.

it's a yoder IT'S A YODER IT'S A YODER

IT'S A YODER!

It's a Yoder IT'S A YODER IT'S A YODER

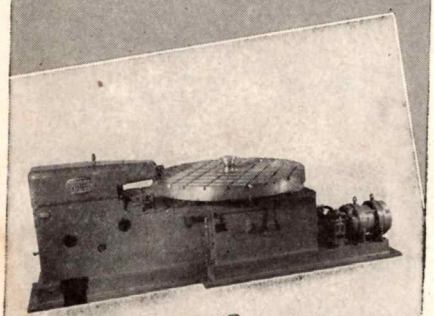
What's a Yoder?

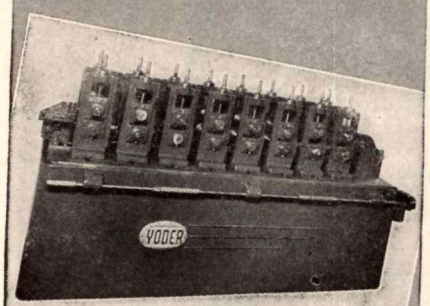
How often have you heard people say, "It's a YODER", when they were referring to a Roll Forming Machine, Metal Slitting Line, Tube Mill Line or Automatic Cutoff Machine?

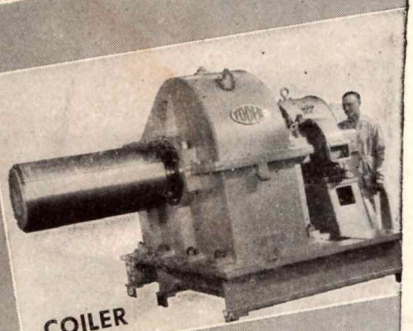
On whom have many manufacturers called, for over thirty years, when they needed engineering skill in "working out" high production metal working machinery problems?

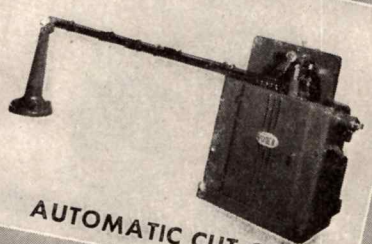
ON YODER!

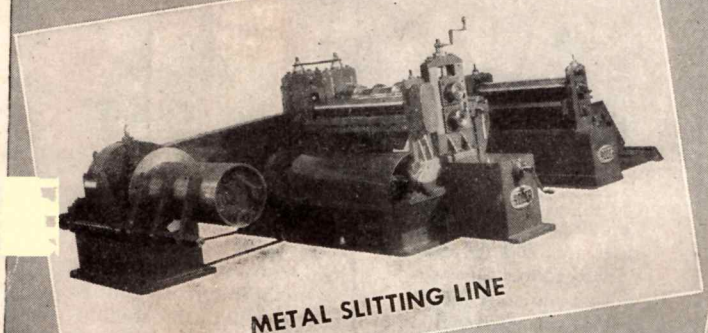
THE YODER COMPANY
CLEVELAND 2, OHIO, U. S. A.

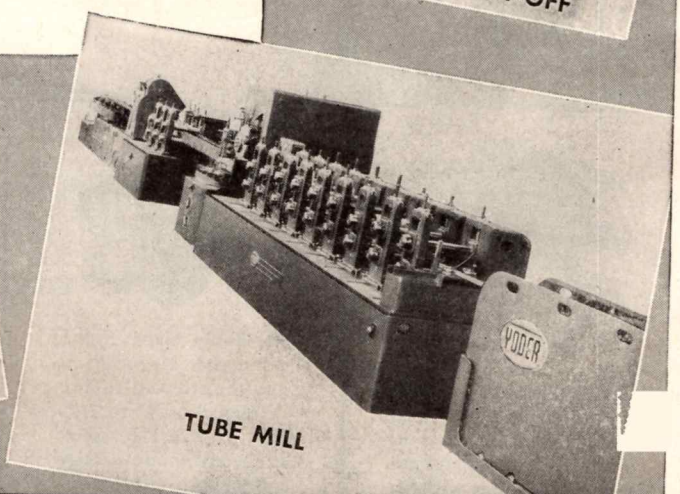

BENDER


ROLL FORMING


COILER


AUTOMATIC CUT-OFF


METAL SLITTING LINE

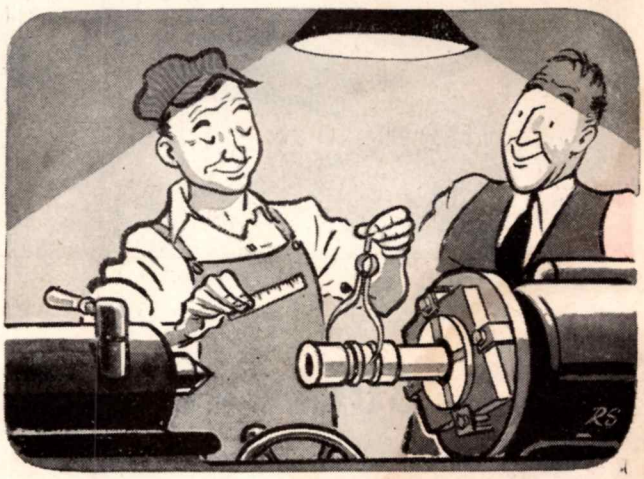

TUBE MILL

HIGH PRODUCTION METAL WORKING MACHINERY

Hey! you forgot something...

1. This is the story of Dave Robeson, and how he lost his shadow. Every time Dave started his turret lathe, his shadow was in the way. "Go ahead," it said, "try to turn that crankshaft down to within a ten-thousandth of an inch. Just try it!" So Dave would try. But every now and then he slipped up—and another piece landed in the scrap heap.

2. One day the foreman had a hunch. He stood for several minutes and watched Dave work. Then he called the superintendent and said, "This guy is working in his own shadow. It's a wonder to me his spoilage is as low as it is!"



3. Dave has lost his shadow. His spoilage is down and his spirits are up! Once the trouble was diagnosed, the electrician simply moved a couple of light fixtures and killed that shadow. Next day, Dave's experiences helped correct similar "bottle-necks" all over the plant.

MEMO TO WAR PLANTS. Little things like shadows, glare, or the gloom caused by dirt and grease on lighting fixtures *are* retarding production, increasing spoilage. A G. E. Lighting Advisor will gladly help, *but* you can easily make your own check-up tomorrow. *Don't waste light.* Remember that G. E. Research has been working continuously for over 50 years . . . to make General Electric lamps stay brighter longer.

MADE TO STAY BRIGHTER LONGER

THE BEST INVESTMENT IN THE WORLD IS IN THIS COUNTRY'S FUTURE...BUY WAR BONDS

G-E MAZDA LAMPS

GENERAL ELECTRIC

Hear the General Electric radio programs: "The G-E All-Girl Orchestra," Sunday 10 p. m. EWT, NBC; "The World Today" news every weekday, 6:45 p. m. EWT, CBS.

. . . Buckeye Equipment goes to work

WAR-TIME refueling must be efficient . . . accomplished without loss of time. Today, on numerous combat, training, and commercial airfields, at home and abroad, "when aircraft get thirsty," Buckeye time-tested refueling equipment gets the job done quicker . . . better.

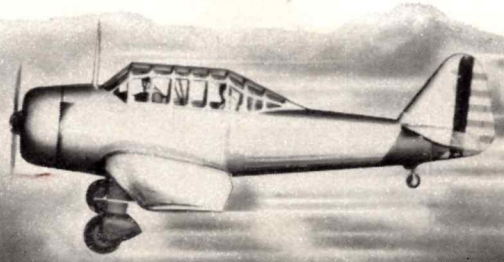
Equipment by Buckeye is easy to use and requires little maintenance. Thus, Buckeye employs manpower sparingly—releasing men for other jobs—and efficiently handles all refueling operations with maximum economy.

Buckeye's pre-war reputation for reliability is proving itself today under the severe test of war-time service . . . The post-war era will find all Buckeye valves and fittings ready to do their part in expanding peacetime airfields to meet increased air traffic and even more rigid specifications. For complete information write to Buckeye Iron and Brass Works, Dayton, Ohio.

Buckeye

QUALITY VALVES AND FITTINGS

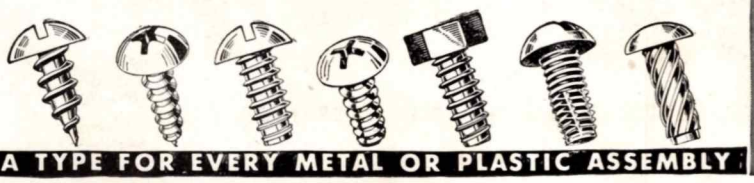
For Airfield Ground Service



FLEETWINGS Solves a "Tough One"

with the aid of P-K Assembly Engineers

P-K Type "Z" Screws with Phillips Recessed flat heads, and P-K Type "A" Screws with slotted binding heads, are driven through metal binding strip and fabric into stainless steel ribs, varying in thickness from .008" to .020". The Phillips Recessed Screw Head promotes speedy driving and prevents driver-slips that might damage the surface.



A TYPE FOR EVERY METAL OR PLASTIC ASSEMBLY

Finds a speedy, secure method of attaching fabric cover to "paper-thin" stainless steel ribs.

In developing a wing surface, FLEETWINGS, Inc., ran into a fastening problem that any engineer would rate "a tough one." They needed to obtain strong, vibration-proof fastenings to stainless steel structures as thin as .008".

But this "tough one," like hundreds of other fastening problems, ceased to be tough when a Parker-Kalon Assembly Engineer was called in. He proved that P-K Self-tapping Screws could be successfully used for the job without the need of auxiliary nuts or supporting members. Fleetwings' Engineering Department reports: "... we found P-K Self-tapping Screws eminently suitable," and, "Parker-Kalon extended fine engineering cooperation ..."

Have YOU Taken Full Advantage of Parker-Kalon's Assembly Engineering Service? Experience proves that, in 7 out of 10 cases, P-K Self-tapping Screws will simplify metal and plastic fastening jobs ... save vital man-hours ... speed production ... cut costs ... and *actually increase fastening strength!* It will pay to question every metal and plastic fastening, on the drafting board and in production! Make sure it can't be made the simple Self-tapping Screw way before putting up with slow, difficult methods. Ask for a P-K Assembly Engineer to check your fastenings. Or, mail a description of your assembly for recommendations. Parker-Kalon Corp., 190-196 Varick St., New York 14, N. Y.

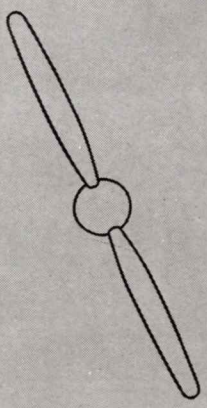
PARKER-KALON

Quality-Controlled

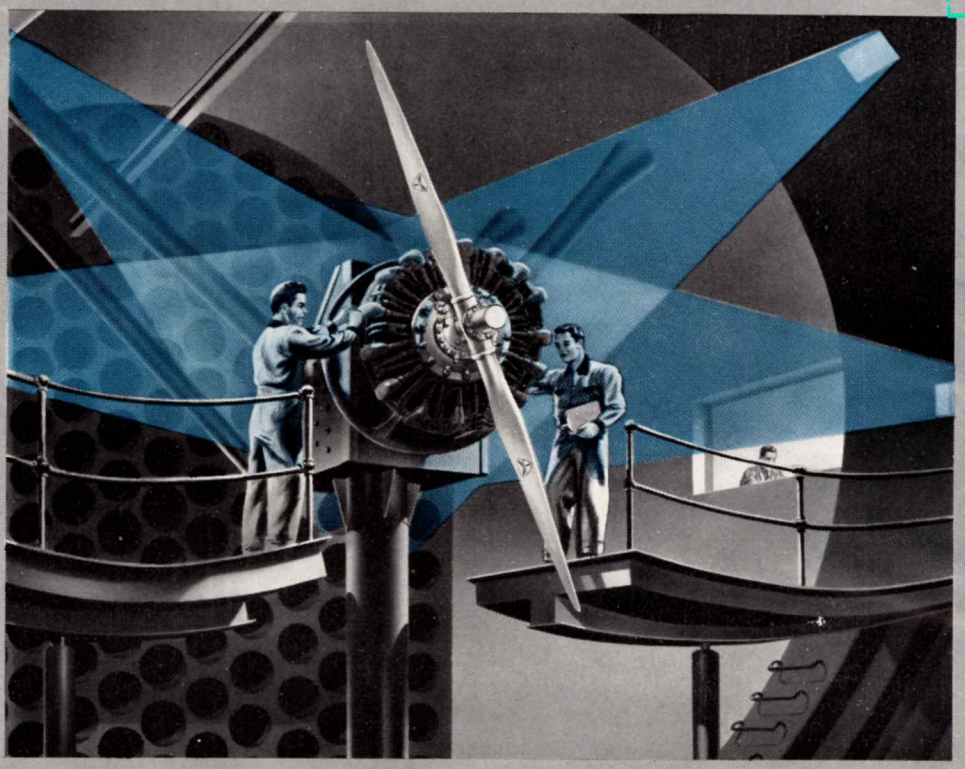
SELF-TAPPING SCREWS

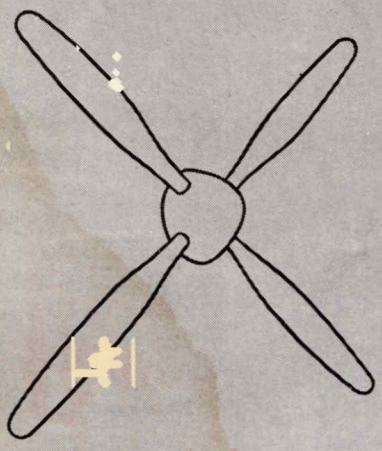
Give the Green Light to War Assemblies

You, too, will fly behind these



1. The TWO-BLADE AEROPROP is shown on the test stand with blades in full-feathered position. This Aeroprop, embodying all Aeroproducts engineering principles, is specially designed for lower-powered airplanes.



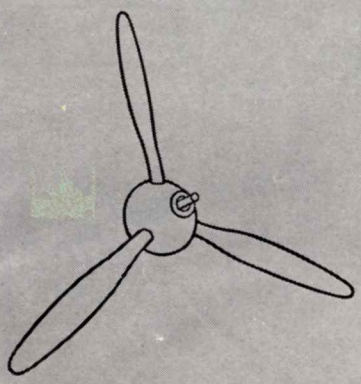


3. The FOUR-BLADE AEROPROP, like its three-blade partner, is versatile, operating either with or without a cannon in its hollow hub. Like all Aeroprops, its pitch action is fully automatic, with the power for pitch changes self-contained in the compact propeller assembly.

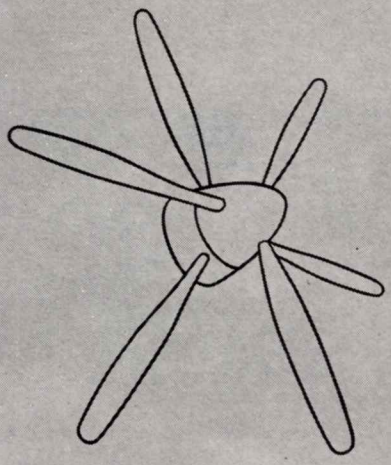
YOU'LL take to the air when this war is won. Perhaps you'll fly behind the two, three and four-blade Aeroprops, designed for service today on many of America's war-planes. Or, perhaps you'll speed through the stratosphere in majestic sky-liners, their mighty engines harnessed by six-blade Dual Rotation Aeroprops. In either case, you will fly in ships whose safety, speed and performance will be enhanced by the advantages of *battle-tested* AEROPROPS.

Aeroproducts Propellers are light, strong, simplified—each a merit of great value. Their pitch action is automatic—swift and precise. Their compact, unit-construction simplifies installation and servicing operations, whether used on radial or liquid-cooled engines. These

"battle-tested" AEROPROPS



2. The THREE-BLADE AEROPROP is a veteran of many battles. Pilots of many Allied nations have flown it and have praised its flight performance, simplicity, and strength.



4. The SIX-BLADE DUAL ROTATION AEROPROP, which is built for specific military use, is destined for equally big jobs when peace is won. This giant propeller embodies the same simplicity of design that is the basic engineering principle of all Aeroprops.

qualities, now contributing to America's military power, will ride the sky-ways with you in the age of peacetime flight.

* * *

Enlarged lithographs of these four illustrations, suitable for framing, will be sent without charge upon request. Write Department PR, Aeroproducts Division, General Motors Corporation, Dayton, Ohio.

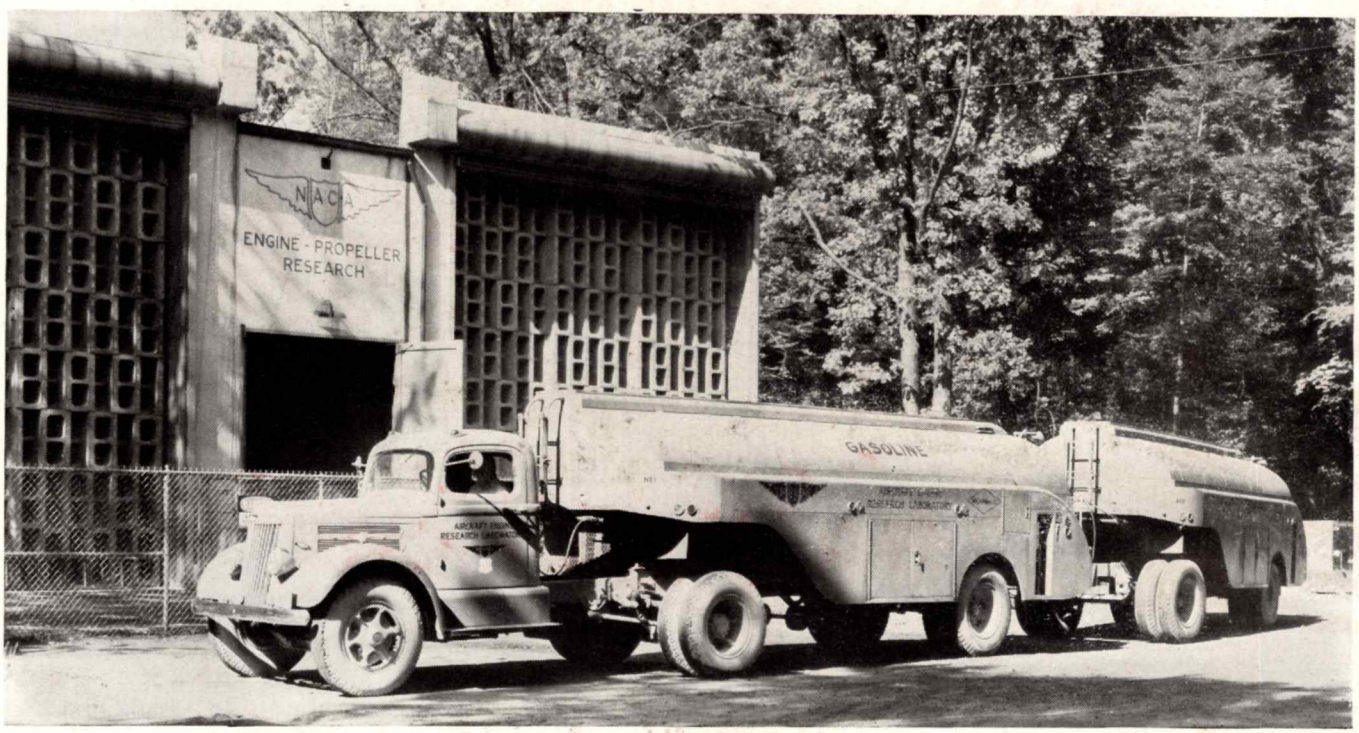
AEROPROP

AEROPRODUCTS DIVISION

GENERAL MOTORS CORPORATION

GM ARMS FOR VICTORY

BACK THE ATTACK — WITH WAR BONDS!



White tractor and tank trailer delivering high octane gasoline to the Engine Propeller Research Building at the NACA Aircraft Engine Research Laboratory at Cleveland Airport—where much of tomorrow's progress in aviation is being written today behind closely guarded doors.

The Truck with the *Aviation Future*

Ever since the early days of aviation, White trucks have served the industry in an ever-increasing number of ways. Building and maintaining airports . . . refueling planes hauling mail and cargo . . . and performing a score of other essential services.

The future will find many more ways for trucks to serve aviation's progress. And much of this progress will come from experiments and research now being conducted by the National Advisory Committee for Aeronautics at its Aircraft Engine Research Laboratory at the Cleveland Airport. A White tractor serves the Engine Propeller Research Unit of the Laboratory, delivering high octane gasoline and special fuel.

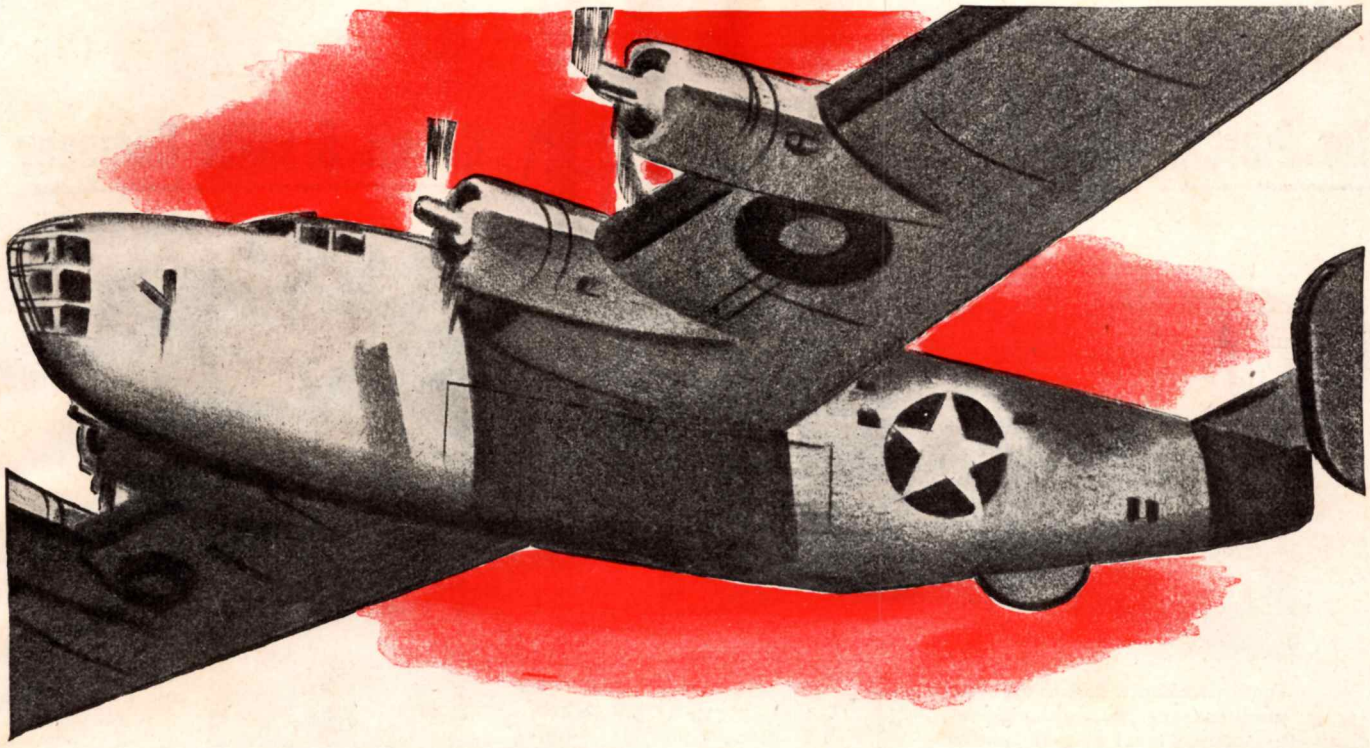
White is co-operating with a number of firms in aviation to solve various phases of their ground transportation problems. Write for any information you need. Your inquiry will receive the attention of men who are interested in aviation and who know "transportation from the ground up."

★ White ★

THE WHITE MOTOR COMPANY • Cleveland

Builders of U. S. Army Tank Destroyers, Scout Cars, Half-Tracs, Prime Movers and Cargo Trucks, the complete line of Super Power Trucks and Tractors, City and Inter-City Coaches, Safety School Busses and the Famous *White Horse.*

FOR MORE THAN 40 YEARS THE GREATEST NAME IN TRUCKS



THERE FLIES 15 TONS OF HEAT TREATED AL-MG ALLOYS

Why Metallurgists Choose Despatch Furnaces For Such Jobs

A bomber like this is built for trouble—from nose to tail. And most of her 15 tons of tough, light aluminum and magnesium alloys owe their strength to exacting *heat treatment* in specially designed furnaces.

To provide such furnaces has been the role of Despatch engineers for years. So today a very large percentage of *all* non-ferrous alloys used in our military and naval aircraft are "Despatch-processed". Why? Because they are convinced by *proved* performance that Despatch furnaces provide exactly the kind of heat treatment required—swiftly, surely, economically.

PROVIDE BETTER CORROSION-RESISTANCE

Take the bugaboo of corrosion. To get real resistance means most accurate heat treatment and almost split-second quenching. No easy job!

But Despatch engineers developed an electronically controlled dual-zoned type conveyor furnace (shown below) which does the entire job *automatically!* Such high corrosion-resistance was developed that a second furnace was ordered at once for another plant.

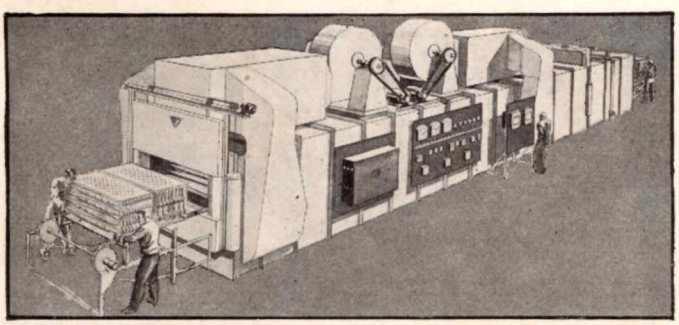
DESPATCH SYSTEM GIVES HIGHEST METAL FACTORS

This is but one example. There are scores of others involving other types of Despatch furnaces for castings, shapes, billets, preforms and rivets.

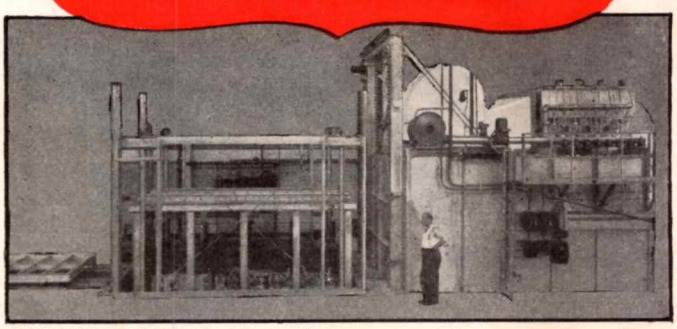
In all types, however, the unique forced convection system is so powerfully efficient that *maximum* physical factors in tensile and elongation are developed. You get just what you want. And electronic controls, robot conveyors, extra-fast quench systems and other new features help make the job easier and *better.*

WE CAN HELP YOU *with your non-ferrous heat treating problems promptly and efficiently, and also assist you in planning* your *future in the light metals industry.* ASK FOR DETAILS TODAY!

DESPATCH
OVEN COMPANY MINNEAPOLIS



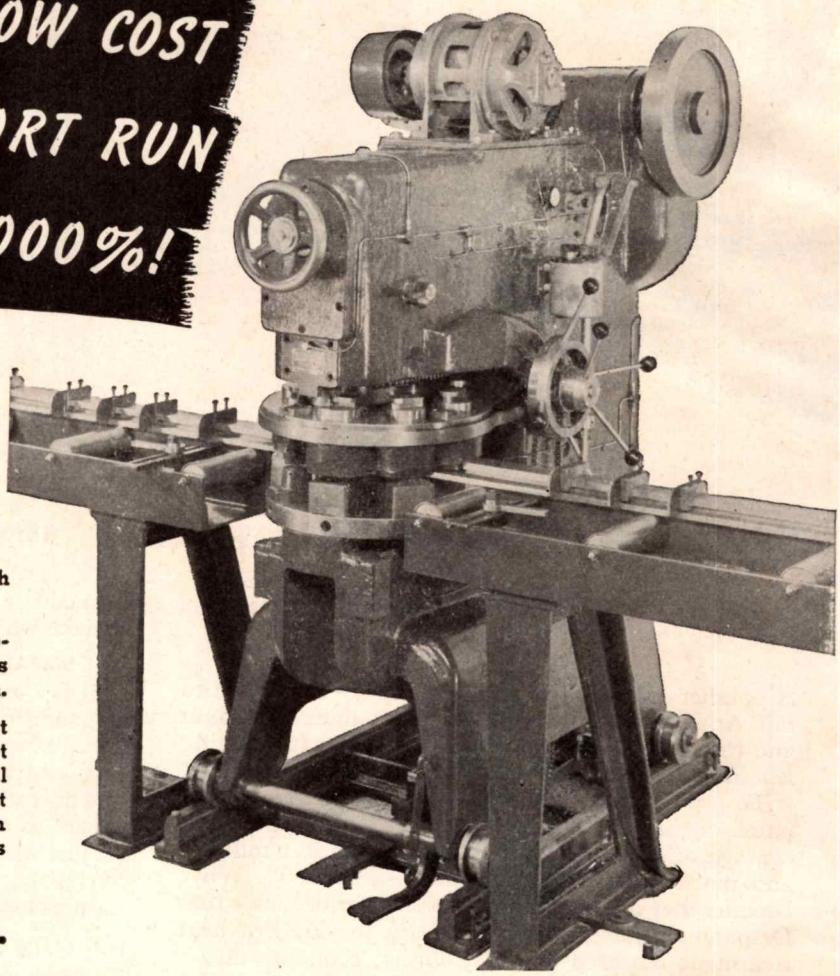
COMPLETELY AUTOMATIC Despatch furnace for heat treating Al. sheets, 400 lbs. per hour. Time-cycle controlled conveyor, doors, quench. Uniformity ± 5° F. Eliminates all labor, except for loading.



ELEVATOR QUENCH system on platform-loaded Despatch furnace allows removal and quench of 8000 lbs. of castings in 20 seconds! Electric or gas-fired (radiant tubes). Very efficient.

for Piercing Copper Bus Bars at I-T-E Circuit Breaker Company

TIME STUDIES SHOW COST SAVINGS ON SHORT RUN JOBS UP TO 2,000%!



The Switchboard Division of I.T.E. produces custom built jobs exclusively — copper must be punched to specifications on each order in lots of from one to 3000 pieces in sizes ranging from 3/4" x 1/8" x 1" to 6" x 1/4" x 120".

The Wiedemann R-5's used at I.T.E. contain 12 stations — 4 with single punches; 5 with double punches; 3 with quadruple punches.

The work is positioned without layout on Wiedemann gauge tables designed to handle 1/4" bus bar up to 12 feet in length and 8 inches in width.

Such amazingly fast production times are not unique. Hundreds of users of Wiedemann Turret Punch Presses with gauge tables are producing all types of accurate short run piercing work at almost unheard of low cost. A wide variety of Wiedemann Turret Punch Presses is available from 6 to 80 tons capacity.

WIEDEMANN MACHINE CO.

1830 Sedgley Ave.

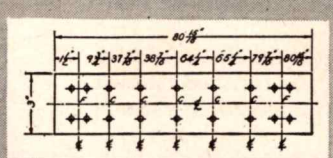
Philadelphia, Pa.

EXPLANATION OF WIEDEMANN METHOD VERSUS CONVENTIONAL METHODS

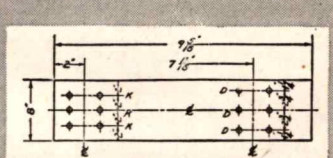
THE OLD METHOD of piercing was done in single operations. Each piece was laid out on short runs. On longer runs layout was made and back gauge and stops were set to layout.

WIEDEMANN METHOD — Single punching is used only where necessary, otherwise gang punches, consisting of 2 to 4 punches, is used.

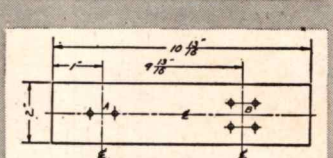
No layout is required. All stops are set by direct reading from blue print.



	SETUP (Std. Hrs.)	PIERCING (Std. Hrs. Per Pc.)
Old	.6	.075
New	.0510	.0121
% Savings	1,060%	510%



Old	.8	.054
New	.0440	.0232
% Savings	1,720%	133%

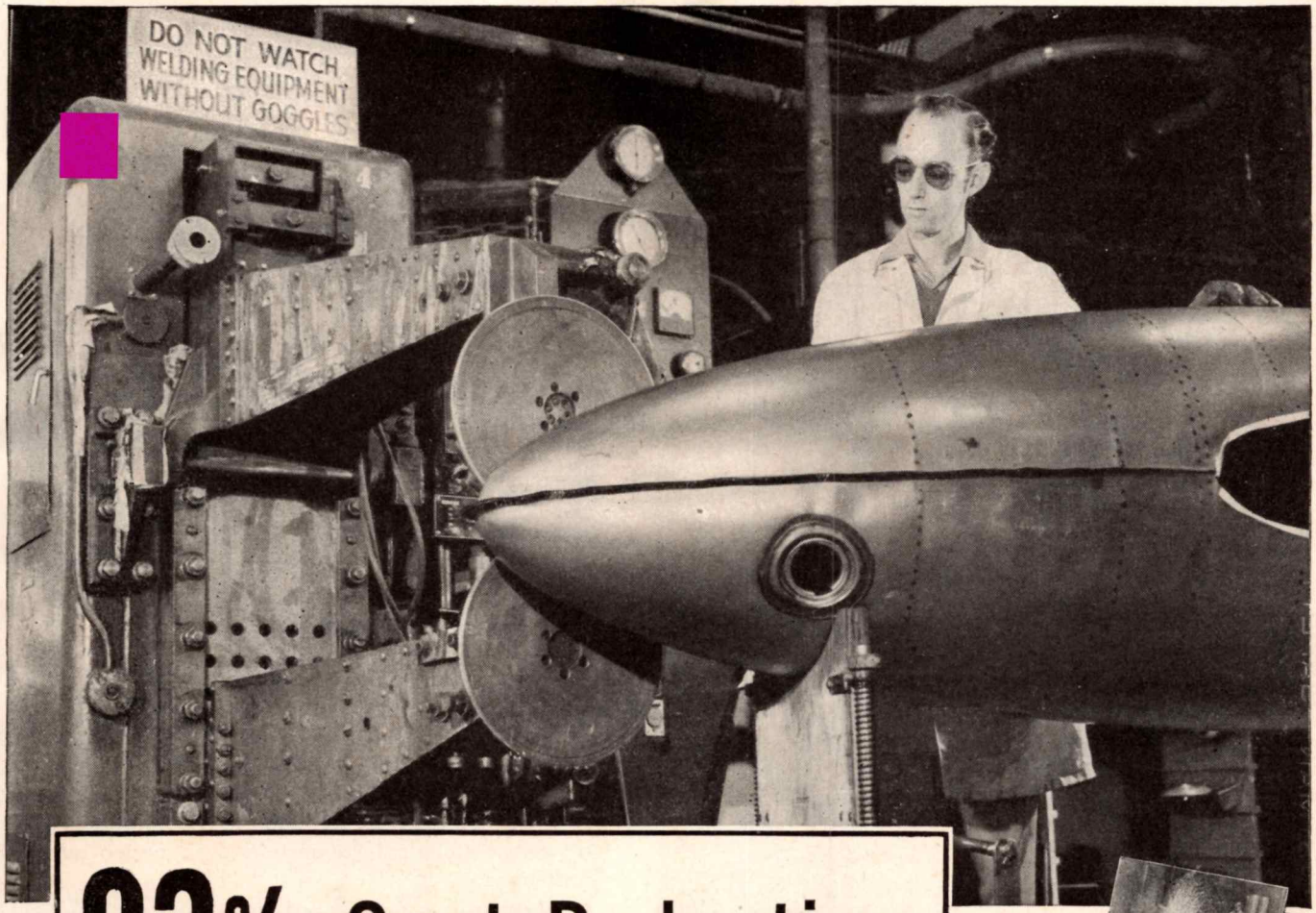


Old	.7	.025
New	.0294	.0042
% Savings	2,280%	490%

GET THE FACTS

Write today for a new descriptive booklet detailing the Wiedemann Method of Producing Short Run Piercing jobs at long-run low cost. A copy is yours for the asking.

WIEDEMANN TURRET PUNCH PRESSES & GAUGE TABLES



83% Cost Reduction *with* ELECTRONIC SEAM WELDING

How Lockheed Saves Man-hours and Material in Building This Fuel Tank

Here is the story as told by R. A. Von Hake, vice president in charge of manufacturing at Lockheed Aircraft:

"The use of resistance welding in aircraft is increasing because of improved controls, welding machines, cleaning processes, and process control. This 150-gallon droppable fuel tank was formerly made of aluminum alloy materials. The bulkheads were spot-welded to the skin, but the two halves were torch-welded.

"Minor redesign, and changing the material to 1010 steel, made possible the change from torch welding to resistance welding, as well as the use of time-saving welding fixtures and other special equipment. As a result, the cost of the tank has been reduced to approximately *one-sixth* the former amount."

The seam welder shown in the photograph is equipped with General Electric *electronic* control. We have a complete line, and G-E electronic-control specialists will help you select and apply the right controls. Contact any G-E office. *General Electric, Schenectady, N. Y.*

ELECTRONIC CONTROL

BUY WAR BONDS

FREE

G.E.'s new 44-page manual, "Fundamentals of Electronic Control for Resistance Welding". Gives basic information on electronic control for spot, seam, and special forms of resistance welding. Written by leading G-E electronic-control engineers. Send the coupon for your copy.

General Electric, Sec. D645-24
Schenectady, N. Y.

Please rush me your new 44-page manual, "Fundamentals of Electronic Control for Resistance Welding," No. GET-1170.

Name.....

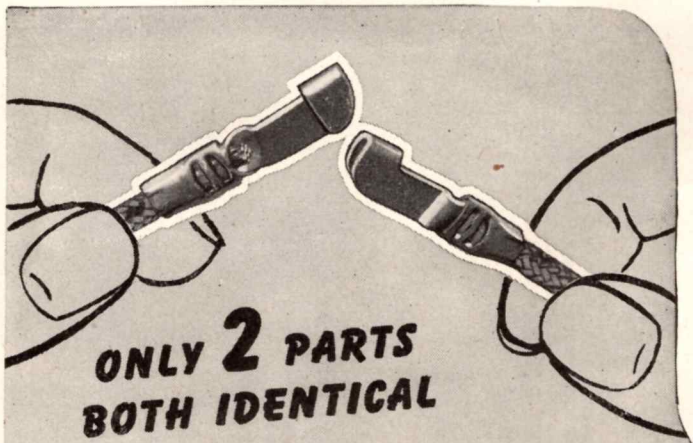
Company.....

Address.....

.....

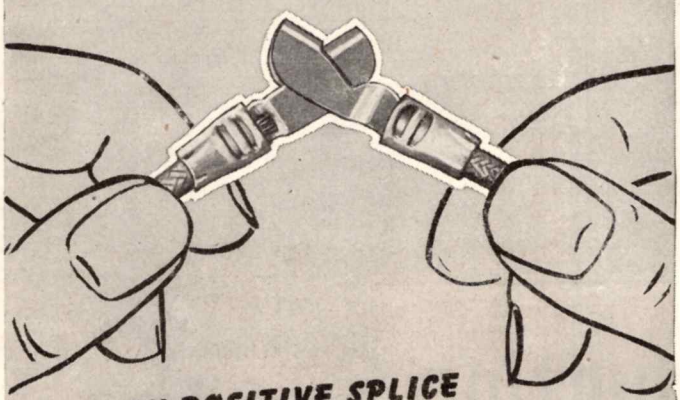
645-24-8960

GENERAL ELECTRIC



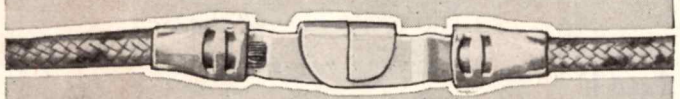
ONLY 2 PARTS BOTH IDENTICAL

Eliminates stocking more than one item. Incorporates AMP Diamond Grip Insulation Support features.



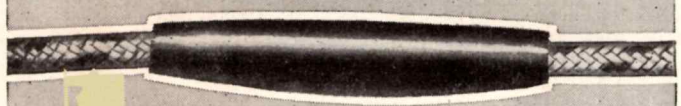
QUICK POSITIVE SPLICE

Knife-Switch principle affords 4 surfaces of direct contact to assure maximum conductivity through the coupling.



STAYS TOGETHER UNTIL INTENTIONALLY TAKEN APART

Tensile strength of splice is greater than that of the wire itself, yet assembly is easily and quickly uncoupled when desired.



CONTOUR OF ASSEMBLY FIRMLY HOLDS INSULATION TUBING

With the tubing in place the splice cannot be accidentally disconnected.

AMP Solderless SPLICING TERMINAL

With Diamond Grip INSULATION SUPPORT

"PRECISION ENGINEERING APPLIED TO THE END OF A WIRE"

1. Unique locking principle using only 2 identical parts — no third part to stock or lose.
2. Four-point "Knife-Switch" wiping action assures minimum contact drop through the coupling, and gives a perfect electrical connection even under adverse conditions.
3. AMP Diamond Grip insulation support gives maximum protection for insulation at wire end of connection.
4. Cannot be uncoupled by pull on the wire — tensile strain on the wire tends to further engage the coupling.
5. Visual inspection after assembly. Wire goes through the barrel of the splicing terminal, insuring against possibility of wire being only partly inserted in the barrel.
6. Makes a connection which will withstand any but the most excessive abuses in service. Flexible copper and simple construction permit easy return to original shape if distorted in service.
7. Insulation sleeving slips over entire assembly with ease. A fairly loose insulation sleeve expands to clasp oval formation of entire assembly — to remain firmly in place until removal.
8. Offset tongue acts as wire stop, preventing the insertion of the wire to a point where it would interfere with the coupling.
9. AMP crimping tools make all three crimps in one operation.

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Canadian Representative: A & M ACCESSORIES, LTD., TORONTO, CAN.

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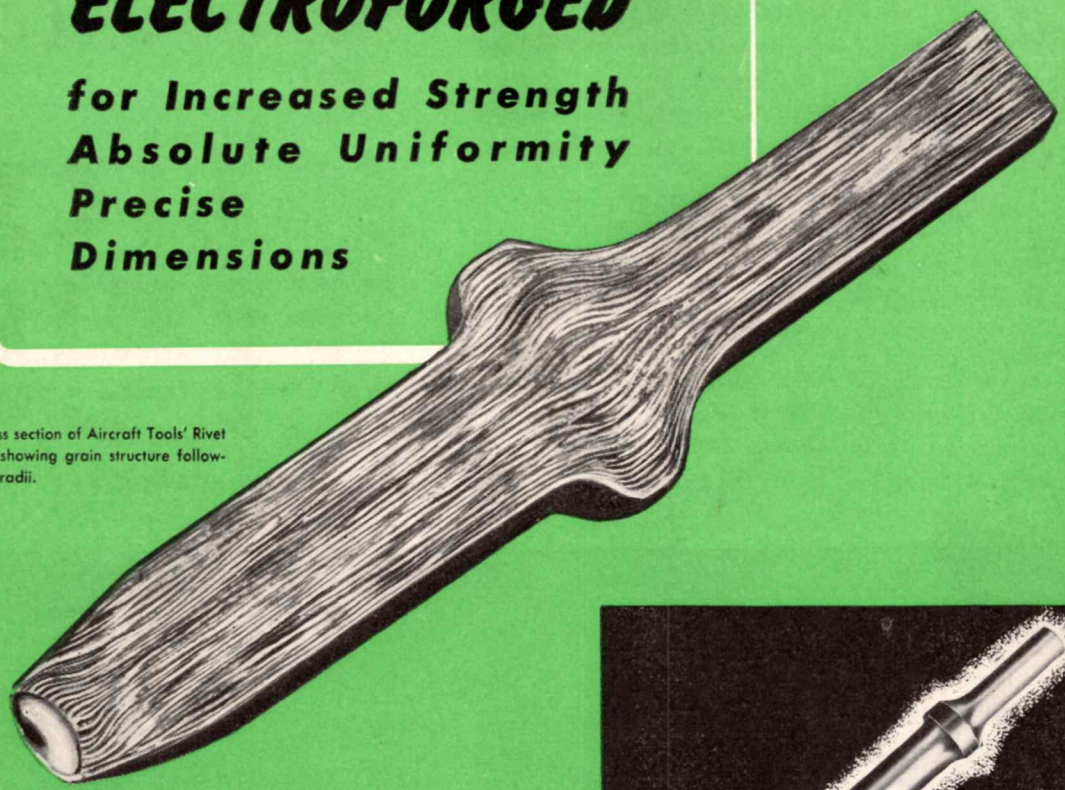
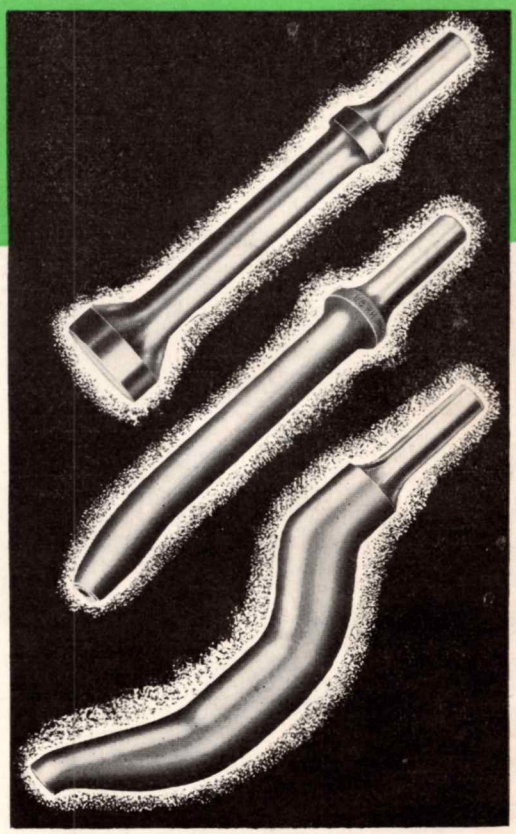
for Increased Strength
Absolute Uniformity
Precise
Dimensions



Cross section of Aircraft Tools' Rivet Set showing grain structure following radii.



Aircraft TOOLS
RIVET SETS

By an exclusive process, all *Aircraft* Tools Rivet Set shanks are forged, so that the grain structure follows the radii. This virtually eliminates breakage and insures accurate and uniform cup dimensions with highly polished cup surfaces guaranteed to conform to rivet heads. Rivet Set shanks are ground to accuracies of .0005" and are available in all sizes with round head, brazier head and modified brazier head.

Please write on company letterhead for ***Aircraft*** *Tools Catalog.*

Aircraft TOOLS, INC.

LOS ANGELES 1, CALIFORNIA

*REG. U. S. PATENT OFFICE

FOREIGN REPRESENTATIVES: The A. R. Williams Machine Co., Ltd., Toronto, Hamilton and Vancouver, Canada ★ The Canadian Fairbanks-Morse Co., Montreal, Canada ★ Reginald M. Levy, Melbourne, Australia ★ Morris Black & Matheson, Ltd., Aukland, New Zealand Emilio Staub & Cia, Ltd., Sao Paulo and Rio de Janeiro, Brazil, S. A. ★ W. A. Ramsey, Ltd., Honolulu, Hawaii

Silenced...the sparks in Sparks' Ears

Yes . . . sparks had to be banished from Sparks' ears, for today radio communication is by voice. Voice communication from crew member to crew member. From pilot to pilot. From squadron leader to squadron leader. From Air General to every one of 9,000 airmen aloft in a 1,000 plane formation.

• Spark signals from the high tension ignition systems of aircraft would completely blot out radio voices. The ignition cables must be completely shielded—electrically and mechanically. Titeflex flexible metallic tubing is doing that job.

• Titeflex Radio Shielded Ignition Harnesses in aircraft perform on the front of the engine directly in a wind stream of over 300 miles per hour. It *vibrates* in mid-air under the full military power of a 2000 hp engine running at 2700 rpm. Rain lashes it in torrents—at tornado force.

• Yet, Titeflex remains *tight* enough to shield a current of electricity at voltages up to *10,000*. And all this at substratosphere temperatures of 50° F. below, outside the tubing. And 300° F. above, at the spark plug end!

• Could any use-test be more convincing—whether the problem be the movement of oil, gasoline, acid, gas, water, steam, or electricity?

• Ask our application engineers to tell you more about Titeflex not only for wartime applications but also for postwar use.

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511 Frelinghuysen Ave., Newark, N.J.

When Engineering Was a Monopoly

There was a time when mathematical knowledge remained the guarded privilege of a few. Counsel based on this knowledge, impressively interwoven in priestly pagan ritual, was only given after heavy tribute had been paid.

For example, the priests of ancient Egypt accumulated vast riches by being able to forecast the flood periods of the Nile. Since farming was the major occupation of the people, information about the rise and fall of the river was essential to the nation's economy. Hidden from the people was the fact that the supernatural predictions of the priests were founded on purely mortal calculations, the result of keeping the calendar and maintaining daily records of the depth of the Nile.

Today, essential knowledge is no longer submerged in ritual. In fact, the knowledge now available to all men, instead of the priestly few, has become so vast, that specialization in all fields is a necessity.

Clearing's specialty is the design and construction of mechanical and hydraulic presses. Clearing presses of unusual and tremendous capacities have been developed, often for applications that represent distinct advancements in production techniques. For production problems that can or might be solved by presses, you can assuredly come to Clearing for worthwhile assistance.

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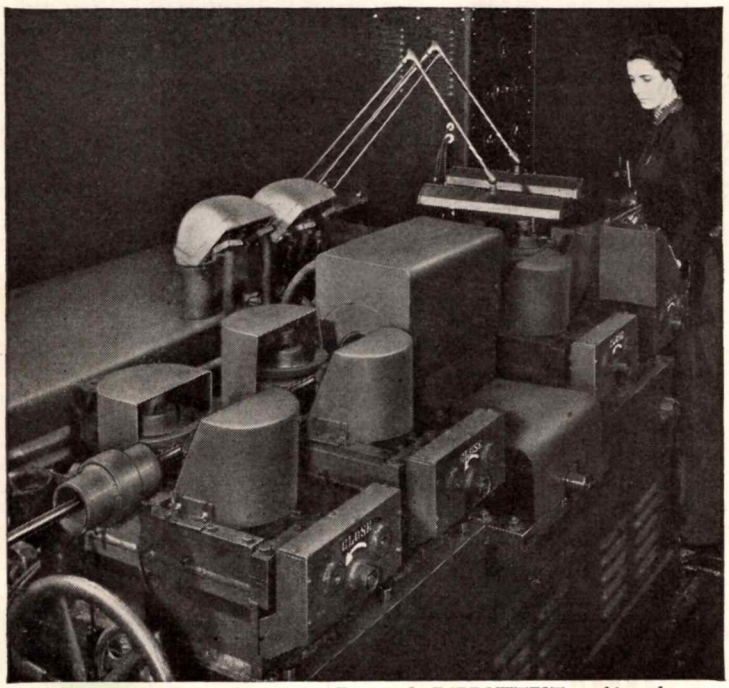
EVERY LENGTH TESTED *by the* Most Accurate Commercial Method For TESTING FERROUS TUBING



A radio-sensitive pick-up coil automatically stops the FARROWTEST machine whenever a tube with an imperfection attempts to pass through it. The test is made electronically—without necessity for relying upon the judgment of the operator.

—and that method is FARROWTEST. It positively locates damaging imperfections in tubing by the means of electronics—even small flaws which would slip by under visual inspection or when tested by ordinary methods.

Because of its high sensitivity and accuracy, FARROWTEST now is recognized as the most thorough commercial test of its type. As such, it provides assurance that tubing passed by it is the most perfect tubing commercially available.

Every length of Republic ELECTRUNITE Aircraft Tubing is subjected to FARROWTEST before shipment—to protect plane

Republic

ELECTRUNITE

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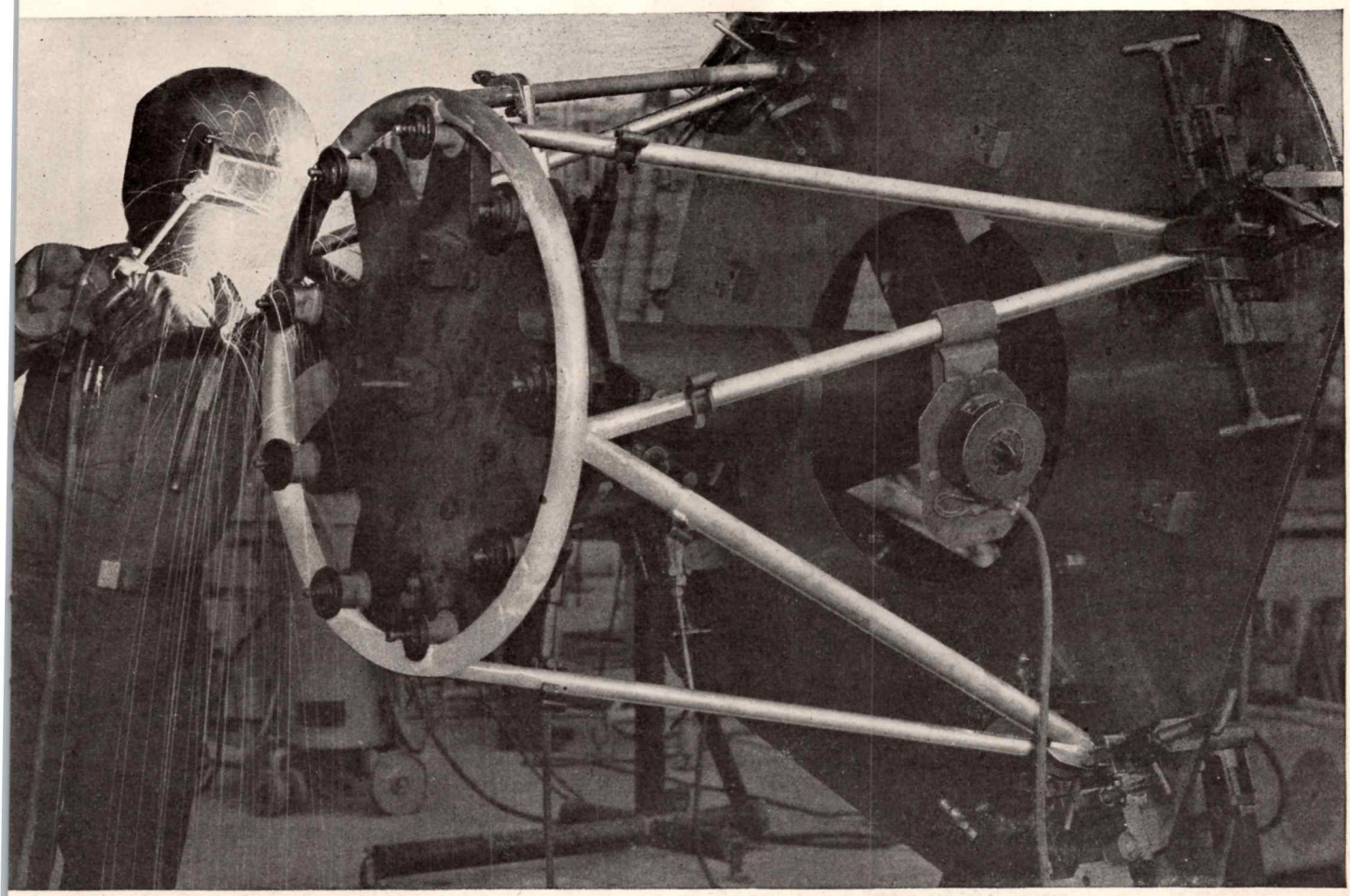

Because of its consistent uniformity, each length of ELECTRUNITE Tubing may be fabricated with the same facility as every other length.

manufacturers against faults during fabrication — to protect pilots and crews against failure during flight.

ELECTRUNITE Tubing also offers aircraft manufacturers the advantages in fabrication and in performance provided by its consistent uniformity of wall thickness, diameter, concentricity, strength, weight, ductility, hardness, weldability and fine surface.

It meets specification standards of the U. S. Army Air Corps; Bureau of Aeronautics, U. S. Navy; and the Civil Aeronautics Administration. It is made in standard sizes from both carbon and alloy steels. Write for complete data.

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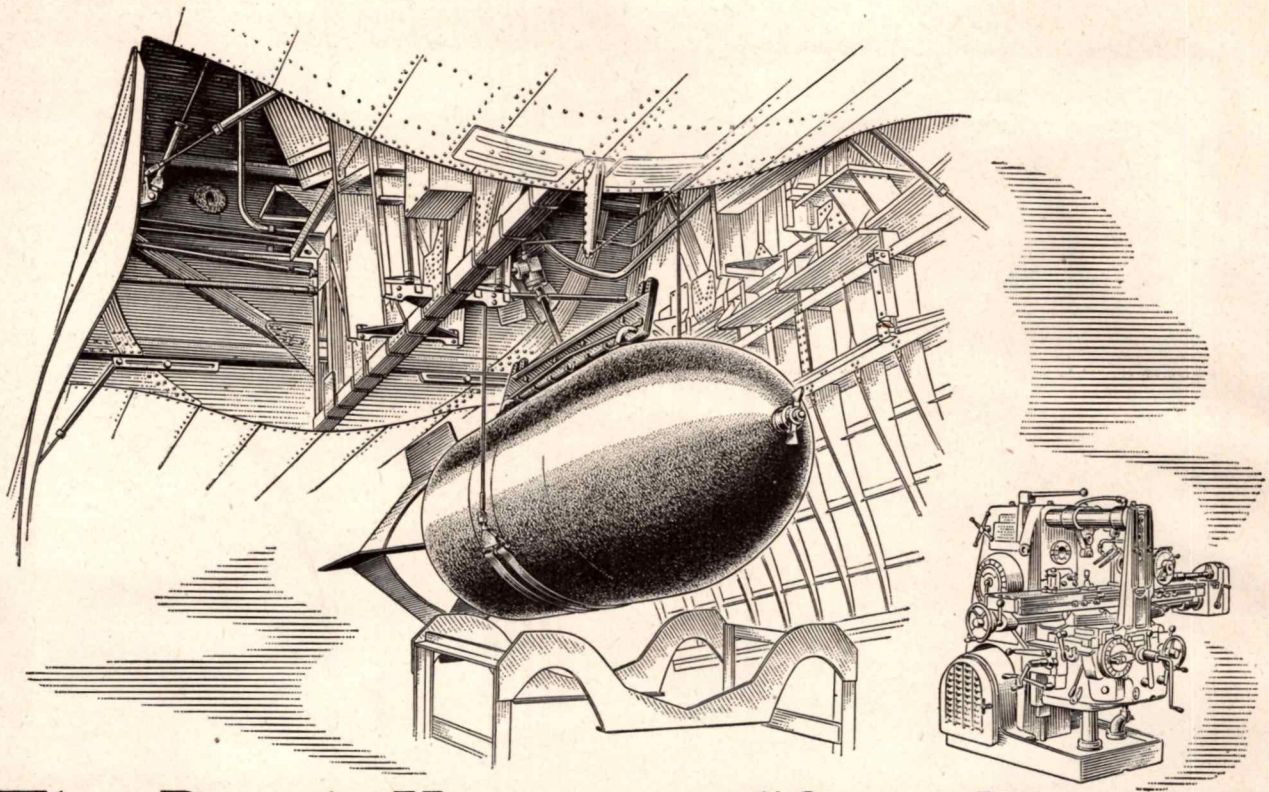
REPUBLIC STEEL PRODUCTION FOR VICTORY

AIRCRAFT TUBING



The Bomb Hoist was *"Struck"* by Something in the Milling Machine

IT MAY BE NEWS to some that a part so long at home in milling machines proved equally effective in bomb ammunition hoists. For the milling machine is a precision tool in which ease and speed of operation are vital. Noted for its anti-friction operation, the Torrington Needle Bearing is used in some of the most famous of these tools to meet just such milling machine "musts" on various hand and power-operated trip levers.

With the bomb ammunition hoist ease of operation is, of course, important, too. But of even greater concern in these days of mightier and mightier "blockbusters" is the danger of overloading. Where bomb hoists do their work, "spares" and often adequate repair facilities may be painfully conspicuous by their absence. That's why the Needle Bearing scored a "direct hit" with the designers of bomb hoists—its high unit capacity helps prevent overloading or breakdowns, and low coefficient gives it a "made-to-order" operating ease.

The pay-off, however, is that this unique anti-friction bearing had several *other* features which helped build a better bomb hoist—its compact size saves weight, increasing maneuverability... its effective system of lubrication means less servicing attention required... its long service life speaks for itself... while the ready availability of the Needle Bearing eliminated one of the most frequent obstacles in war production—delay in delivery.

ISN'T THIS SOMETHING TO THINK ABOUT in planning your postwar designs? Not alone because of the Needle Bearing's adaptability to a wide variety of products for entirely different reasons, but also because its unique combination of advantages represent the very features customers will be looking for Tomorrow in the things for peacetime living—light weight, compactness, ease of operation, freedom from maintenance and long life. Torrington engineers are ready to point out how you can give your product these same advantages with the Needle Bearing. For preliminary information on sizes, types and ratings, together with a list of typical applications, send today for Catalog No. 112.

NEEDLE BEARINGS—ALL TYPES—ALL SIZES

NEEDLE BEARINGS TYPE DC are complete, self-contained units consisting of a full complement of rollers and a drawn, hardened outer race. They offer the advantages of small size, low cost, high capacity—and easy installation.

NEEDLE BEARINGS TYPE NCS consist of a full complement of rollers and a relatively heavy hardened outer race. They are furnished with or without inner races. Needle Bearings Type NCS are adaptable to heavier loads than Needle Bearings Type DC.

NEEDLE ROLLERS TYPE LN are produced in a range of types and sizes for assembly on the job into low-cost, high-capacity, anti-friction bearing units. Our engineering department will be glad to advise on the correct size and type for any application.

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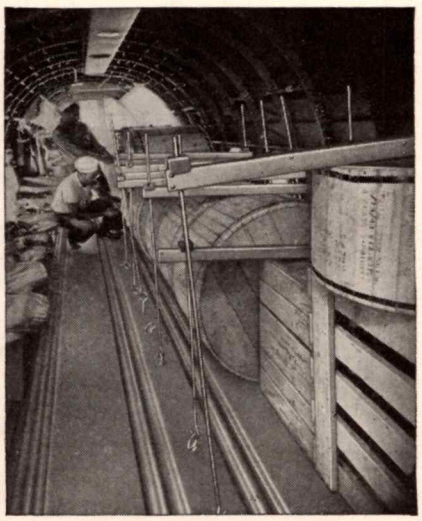
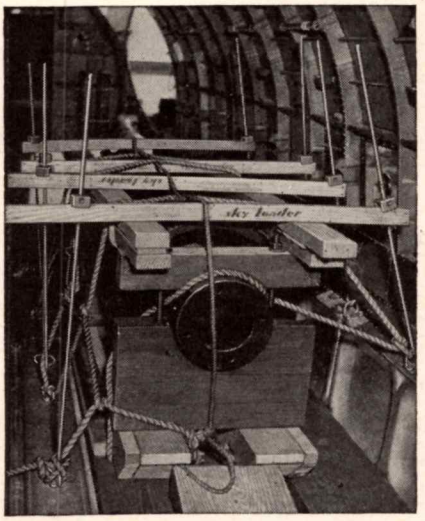
LET'S GO! U.S. KEEP 'EM FLYING

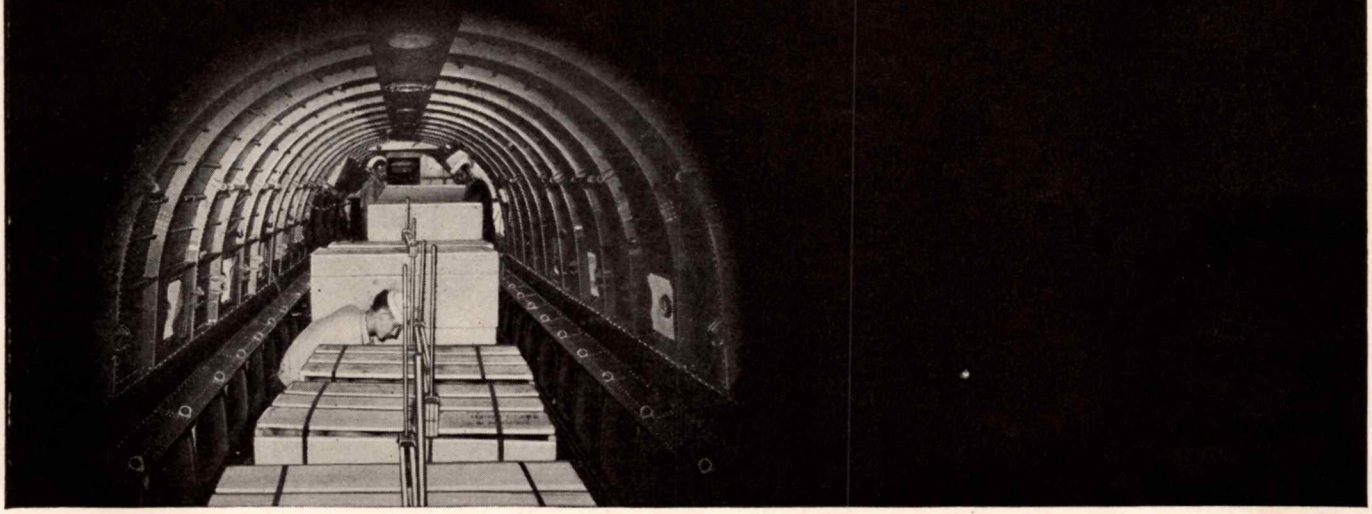
TORRINGTON NEEDLE BEARINGS



Skyloader metal tie-down rods attached to deck rings, and hardwood beams locked tight against the cargo make it part of the airplane. All slack is removed!



The Skyloader kit makes possible a tie-down combination of rods, beams, ropes and rope tighteners to hold odd-sized freight in flight secure against all strain.



bound for Burma

Over the trackless wastes of the Far East, the impassable jungles and "bad lands" of the world go sky-borne cargoes—today, guns and supplies of war—tomorrow, the goods of peaceful commerce.

Designed to simplify and systematize the new job of stowing air cargo, the Evans Skyloader method brings safety, speed and lightness to air shipments.

Evans Skyloader method offers: 40 to 50 per cent saving in the tie-down time of on- and off-loading; safety in flight for personnel, cargo and plane; important reduction in the weight of lashings and the use of costly rope.

On thousands of flights for military commands as well as commercial air shippers, Evans Skyloader method is proving its efficiency. Our engineering staff will gladly study your special loading problems.

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Vision to Anticipate the Needs of Tomorrow
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FORGINGS that GAIN TIME

Confronting all of us today is the supreme task of making time, because it is such a vital element in the strategy of modern warfare. T & W makes forgings that gain time . . . time that results in more war production at a faster rate. Plus or minus a few minutes of time at any stage in forming a forging may gain hours in the length of time it takes to get the forging onto your assembly line. T & W Forgings usually require less machining and finishing and that's where they gain time for you. Ask a T & W Forging Engineer about forgings that gain time.

FORGINGS

USUALLY COST LESS
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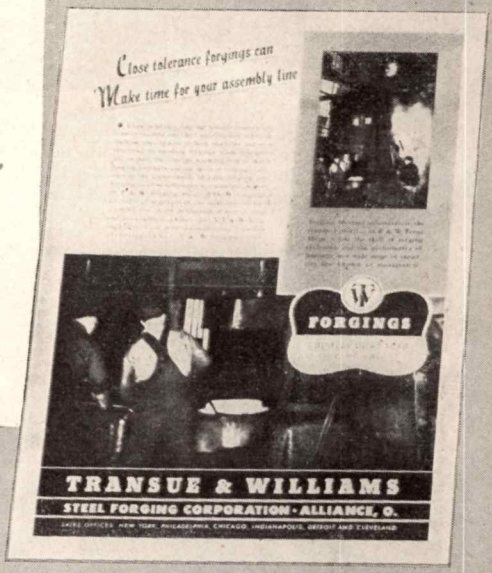

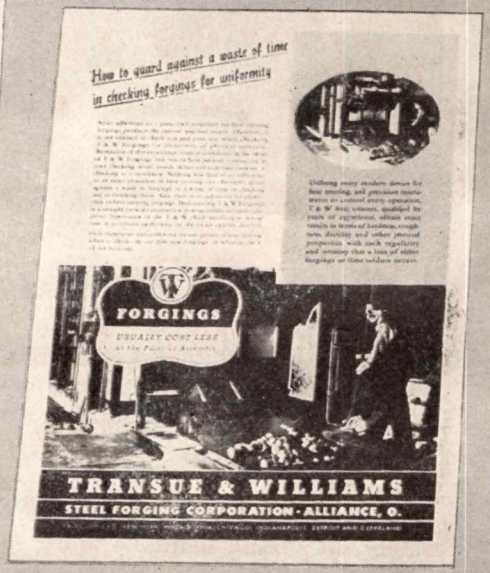

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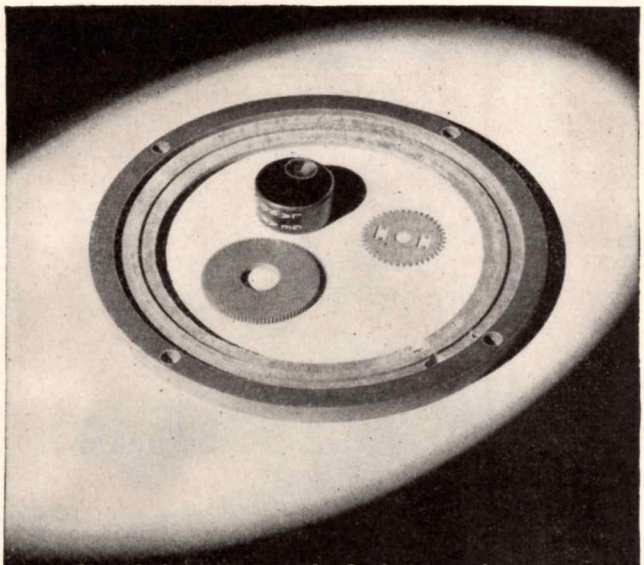

Our fighting aircraft find extensive use for parts made of both National Vulcanized Fibre and Phenolite, laminated Bakelite. These materials possess unusual lightness in weight, great dielectric strength, and exceptional wearing qualities.

GOING TO WORK

HURRYING "upstairs" to take on the japs "coming down the alley" is the way our boys in the Pacific are going to work. There're no time clocks or 8-hour days for them. It's full time all the time. And when we read "X number of our planes failed to return," it should blast all complacency from us. It should wake us up to the fact that more sweat in work, more blood to the Red Cross, more money in War Bonds are the least we can give to save vital time—to make their sacrifices less.

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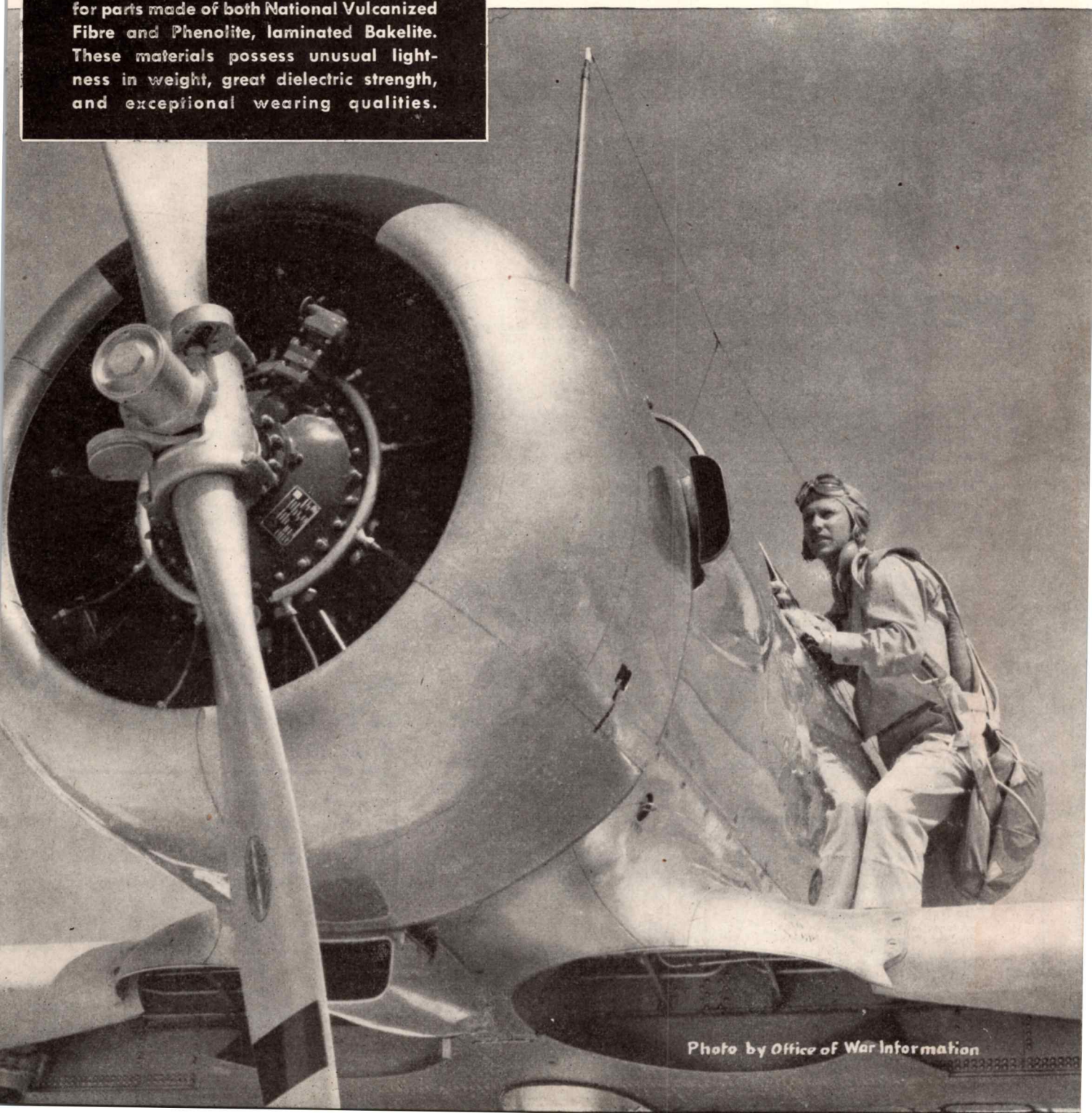

Photo by Office of War Information

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COLLEGE DEGREE IN *Aviation*

Here is your opportunity to get a Junior College Course in Texas' oldest Aviation College that can be the stepping stone to a brilliant career in the global field of aeronautics.

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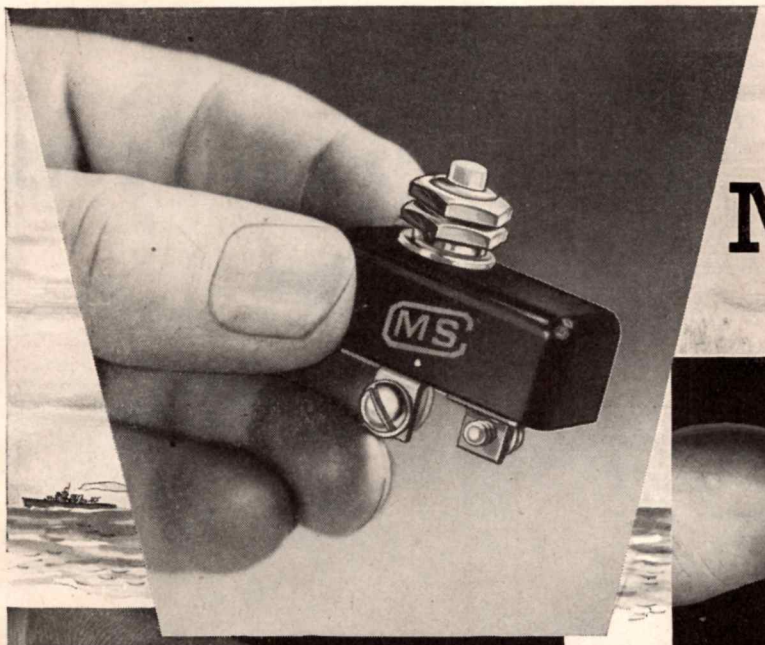

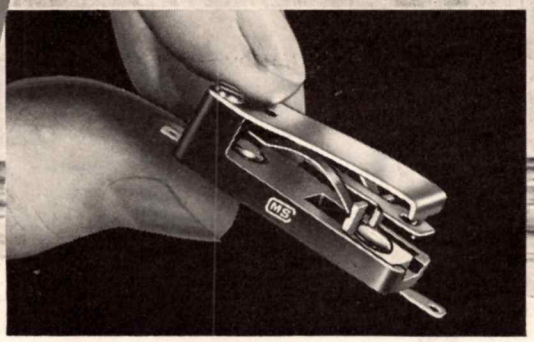

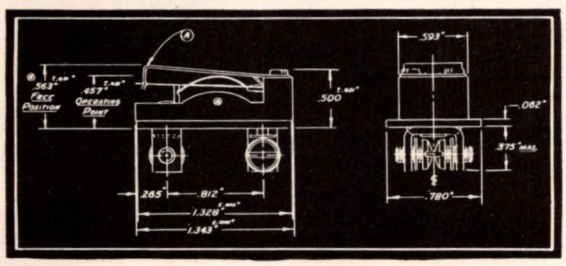

...that is meeting high favor with Aircraft Engineers

Designed for post-war use, the Peanut Micro Switch so filled the bill for a number of military aircraft requirements that we are now making them in large scale production.

This diminutive switch is smaller than the basic Micro Switch, is very robust, highly resistant to vibration, is lighter in weight and lower in cost.

The Peanut Micro Switch is so designed that it can be used without an enclosing case, allowing the actuating movement to be applied anywhere over a large portion of the upper spring. Used with a Bakelite case, a convenient stem mounting is provided. The construction allows inherent overtravel beyond the point of operation sufficient for most uses.

The Peanut Micro Switch, encased in Bakelite housing, weighs .048 lb. This switch resists vibration and acceleration up to 300 times gravity. Operating force is 33 ounces maximum and the movement differential is 0.040" maximum.

Contact separation up to .085" can be varied in manufacture to meet requirements. This wide gap is particularly valuable on DC loads. To provide the high unit contact pressure for most voltage applications, contacts of 99.95% pure silver are formed with a knurled surface.

Experience and skill of Micro Switch engineers is at your service. Send for information.

Send for Catalog No. 70 for general data on Micro Switches for aircraft. Ask for as many copies as you need.

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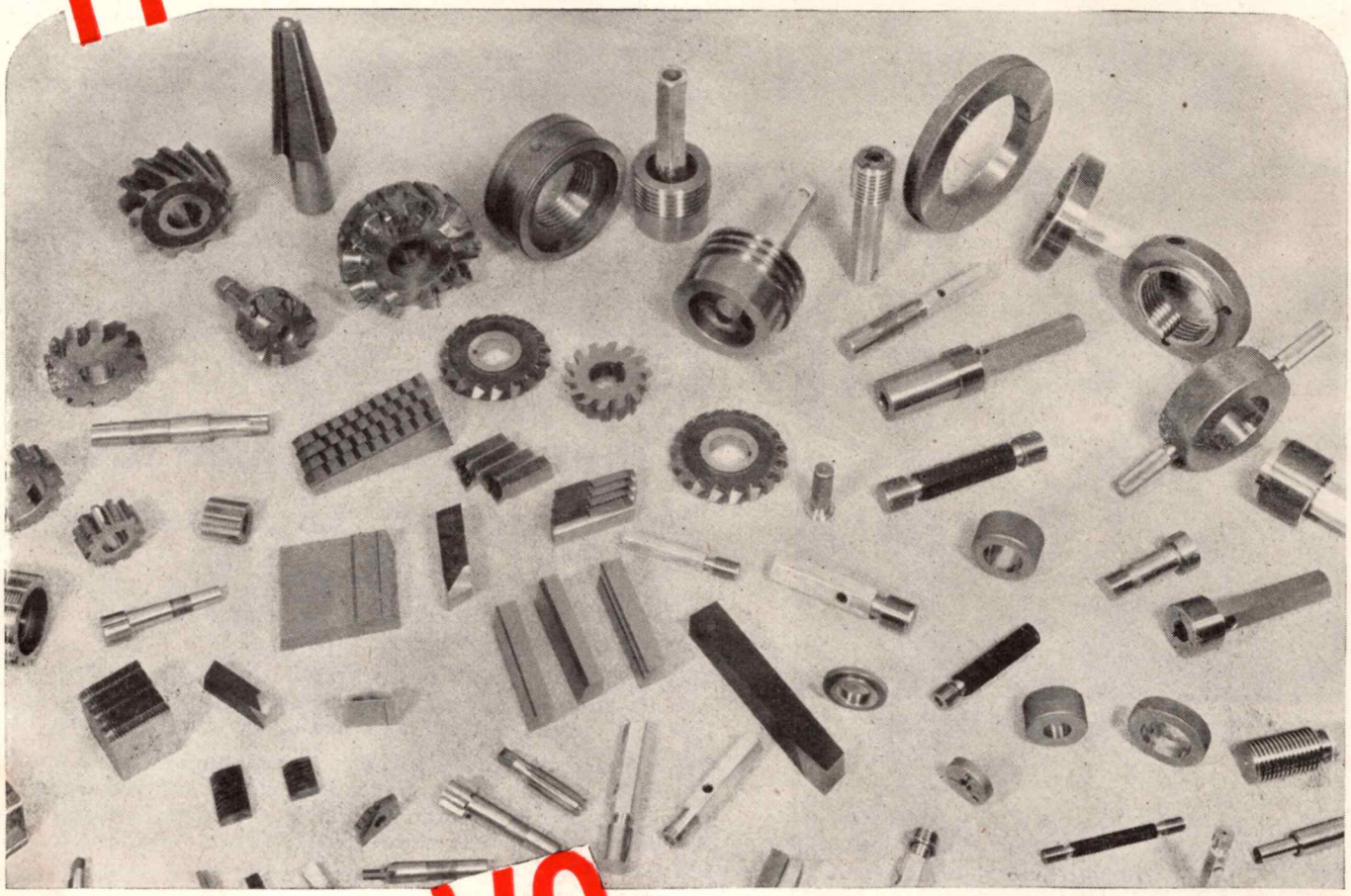

IT PAYS to take care of Good Tools

The PIPE MACHINERY COMPANY Cleveland, O.

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The Fledgling Has Grown His Wings

OFFICIAL PHOTOGRAPH, U. S. ARMY AIR FORCES

Fenn's Aviation Parts Production was only in its infancy at the start of the war, but now the fledgling has grown its wings. It's on its own . . . FENN AIRCRAFT DIVISION . . . with its own plant at New Britain, Connecticut.

Fenn Aircraft is headed by a capable staff of engineers and production men, well versed in tool design and tool engineering. Forty years experience in precision manufacturing to close tolerances is behind this staff.

Fenn Aircraft is specializing in the manufacture of precision-built parts which are assembled into components before shipment. These sub-assemblies are ready to be put right on the assembly line, accurately built to the specifications of the aircraft manufacturer.

Fenn Aircraft **NEW BRITAIN CONNECTICUT**

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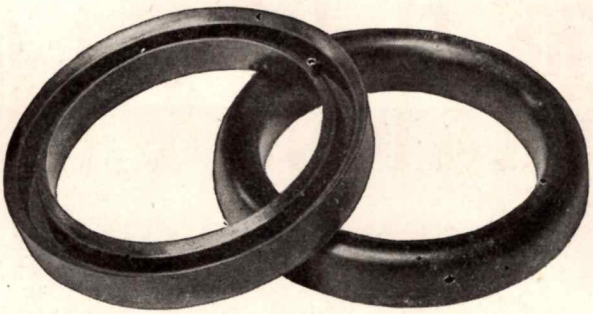
MANUFACTURERS OF AIRCRAFT SUBASSEMBLIES AND PARTS

GRATON AND KNIGHT

GRATON & KNIGHT ENGINEERS *Present* PACKINGS POINTERS

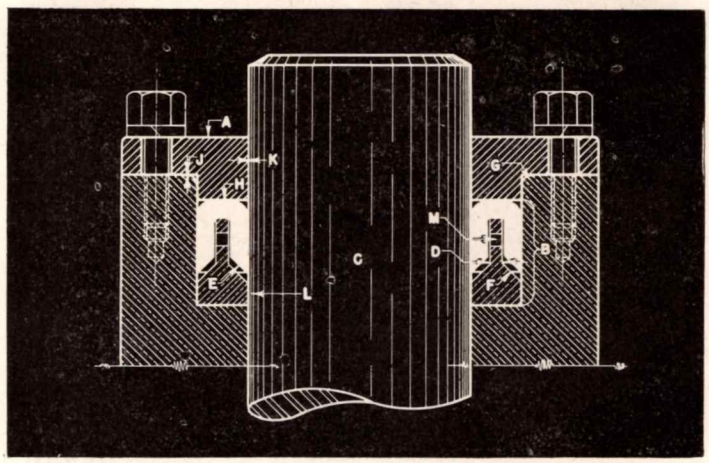
No. 3 in a series of articles discussing the fundamentals of packings design and application. The first four articles will deal briefly with the four common packing types. Other phases of selection and application will be discussed later.

Reprints of each article are available, free. If you would like to make a collection, please write to Packings Department H, Graton & Knight Company, Worcester 4, Massachusetts.



THE "U" PACKING — The "U" is the packing most commonly used in a stuffing box to seal a reciprocating piston.

Installed in the stuffing box with the sealing lip facing the pressure medium, the flexible legs of the "U" are free to expand under the pressure of the medium, forming a seal on both the inside and outside peripheries.



DESIGN CHARACTERISTICS

A. A packing follower (or "gland") is used to hold the "U" packing in the packing recess. **B.** The packing recess (or "stuffing box"). **C.** Reciprocating piston. **D.** A "throat ring" or "pedestal ring" is used to support the packing and prevent collapse when the pressure is off. When the follower is tight at J, a *very light* squeeze is exerted on the base of the U to hold it in correct position. (Flax fillers are sometimes used *in place of* pedestal ring.) **E.** Bevel on "U" packing. **F.** Bevel on throat ring. **G.** Taper on recess for ease in assembly. **H.** Square nose on follower. (Sharp corner of concave nose will damage packing.) The top of the packing will soon conform to the shape of the recess. **J.** Metal to metal contact. **K.** Minimum working clearance. **L.** Vertical grooves for free admission of medium to packing. **M.** Holes drilled through ring allow the pressure medium to act on the outside leg of the U.

CLEARANCES

1. Between the bevel (F) of the throat ring and the bevel (E) of the packing, to protect the lip of the packing and to permit the pressure to enter and spread the U.

2. Between the throat ring and the inside wall of the packing to prevent binding — 1/3 leather thickness.

3. Radius at top of throat ring to prevent cutting the packing.

4. Between follower and piston. The smaller the clearance, the longer the life of the packing. Excessive clearance, which permits extrusion of the packing, causes about one half of all packing failures.

World's Largest Industrial Leather Plant

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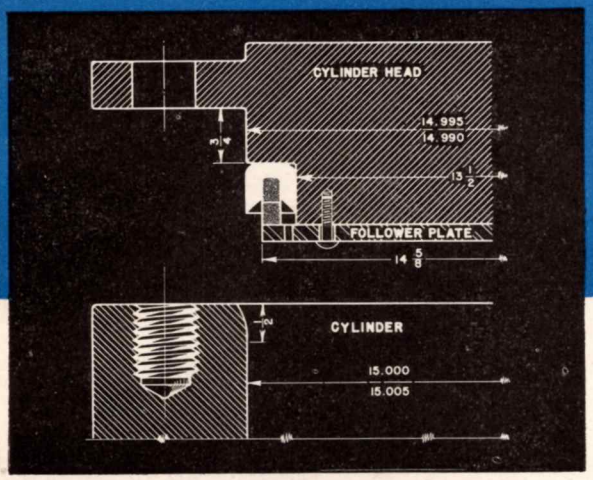
Recommendations at the "PACKING POINT"



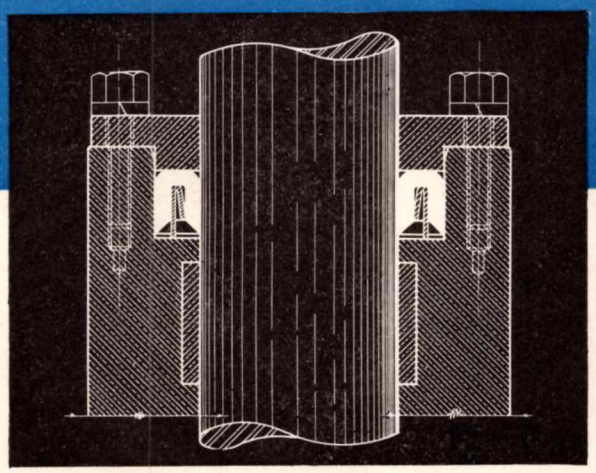
Case No. 1 Hydraulic Application — Static Seal

Equipment: hydraulic forging press cylinder head.

Operating conditions: 2000 p.s.i. oil. Absolutely no leakage allowed.

Equipment design: Cylinder head acts as backing plate . . . follower plate is drilled to permit medium free access to packing . . . filler in packing protrudes, with the result that it is squeezed by the follower enough to flare the packing slightly and insure tight fit (with a static seal, there is no friction problem) . . . deep smooth chamfer in cylinder insures easy assembly without damaging packing . . . cylinder head is long enough to enter the cylinder beyond the chamfer, giving the packing adequate support and preventing extrusion.

Packing: Graton & Knight Spartan Leather, especially impregnated for the purpose.



Case No. 2 Pneumatic Application

Equipment: double-acting air cylinder.

Application: piston rod packing recess or stuffing box.

Operating conditions: 90 to 125 p.s.i. air pressure . . . ordinary factory temperatures.

Equipment design: bolted follower plate, designed according to standard practices outlined on opposite page . . . finger-type expander keeps U in positive contact with the piston . . . also acts as throat ring.

Packing: Graton & Knight's Spartan Leather especially treated for resiliency to provide quick seal.

SPARTAN LEATHER PACKINGS AND A SERVICE THAT BUILDS CERTAINTY AT THE POINT OF SEAL

Graton & Knight's SPARTAN emphasizes the many advantages of leather as a packings material —

wearing quality . . . low coefficient of friction . . . flexibility at low temperatures . . . adaptability to wide range of mediums . . . economy

and adds the following qualities, which result from the exclusive Graton & Knight SPARTAN tannage —

the resistance to heat and oil of top-quality chrome leather . . . a mellowness and flexibility not found in the usual chrome tannage.

Spartan has highest resistance to heat (withstands boil test), and will not dry out hard and brittle. It is acknowledged the top-quality leather in the packings industry.

The combination of proper selection of sealing material plus correct application has made Graton & Knight engineers the No. 1 source of practical, time-saving aid for machine designers.

When your design reaches the "packing point" — or when a packing trouble arises — call on G&K engineers.

the hand that builds certainty at the point of seal

GRATON & KNIGHT COMPANY

WORCESTER 4, MASSACHUSETTS

GRATON AND KNIGHT

He takes 'em there ...and back!

BACK THE ATTACK—WITH WAR BONDS

The navigator's job is heavy with responsibilities. His is the task to put the ship over the target . . . and bring it safely home. Wire, too, plays an important part in getting the plane there and back.

Bombing crews and fighter pilots rely on the miles of wire which thread every plane. Wire for the "inter com," for landing and signalling lights, wire that relays the condition of engines and fuel. That is why Dependability is a "must" in every type of wire and cable manufactured by Auto-Lite to meet the rigid demands of this exacting industry.

You can get complete details — in Form No. 838 covering Low Tension Cable; in Form No. C-503 covering Steelductor Cable, the High Tension Wire now used in the majority of America's fighting and bombing planes. We'd appreciate your making sure these valuable bulletins are in your file.

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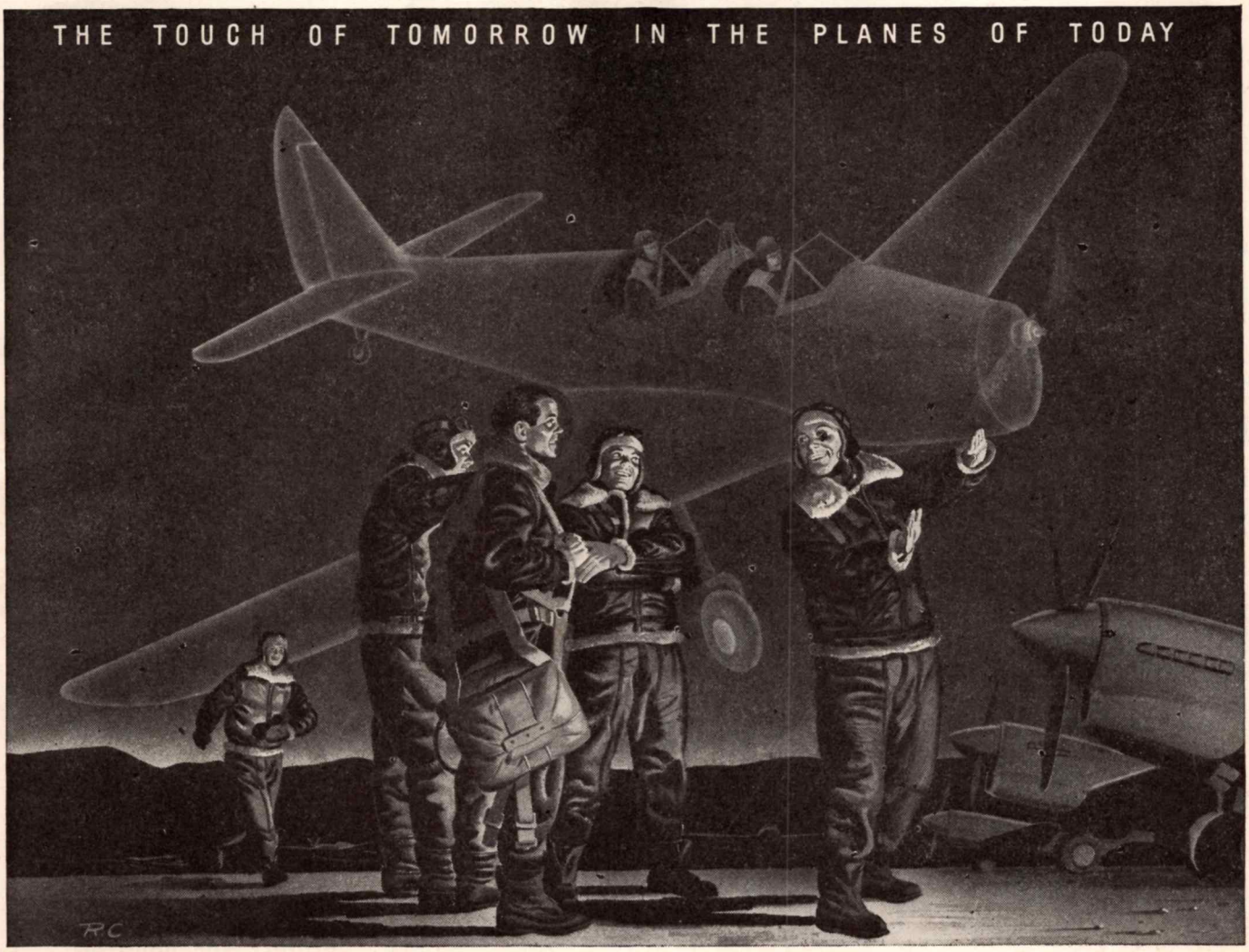
SARNIA, ONT. *Wire Division* PORT HURON, MICH.

AUTO-LITE AIRCRAFT WIRE and CABLE

IN ITS 26 GREAT MANUFACTURING DIVISIONS, AUTO-LITE IS PRODUCING A LONG LIST OF ITEMS FOR AMERICA'S ARMED FORCES ON LAND, SEA AND IN THE AIR



Reunion on the Field of Battle

These are Fairchild alumni—fighting men from Norway, Canada, the U. S. A.

Though they come from different parts of the world, these skillful warriors of the United Nations Air Forces have much in common.

Typical of thousands of fliers on every fighting front, each was given an intensive course in a Fairchild Primary Trainer as one important step on the road to winning his wings. Their meeting upon some distant airfield is virtually a reunion of "old grads" of the same Alma Mater.

It is easy to understand why the Air Forces choose Fairchilds for primary training.

There is the element of added safety. For example: quick take-offs and steep climbs can be performed by novices in a Fairchild Trainer without danger of stalling, which caused so many fatalities in the last war. The trainee, behind a 175 or a 200 horsepower Ranger engine, just "pours on the coal" and he's quickly in the air with a lot of runway to spare.

And when it comes to acrobatics, which give a trainee an intimate feel of the controls and teach him instinctive flying, a Fairchild is the answer to an instructor's prayer. No need to crush the student's confidence by telling him not to dive at high speeds. Just teach him all the tricks in the bag, with the full knowledge that safety has been built into every inch of every Fairchild Trainer.

Maneuverability with great safety, and rugged landing characteristics—for which *all* Fairchild trainers are famous—provide the foundation stone of Fairchild's "touch of tomorrow in the planes of today."

BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland.....Burlington, North Carolina

This FIRE PROTECTION

by CARDOX Fire Extinguishing Systems

More war goods from fewer man-hours is one of America's most urgent needs today! Every hour saved here is another step toward victory.

One major fire—or a small fire that results in crippling damage by the extinguishing medium—can cut the flow of vital war goods to a trickle over night. Such fires may halt or slow down production on a dozen essential fighting tools . . . waste precious man-hours and critical materials.

Cardox Fire Extinguishing Systems provide distinctive advantages in protecting production against these war-prolonging fires. They smother the fire and "cool out" combustibles through timed mass discharges of *pounds* or *tons* of CO_2 . . . with no damage by the extinguishing medium. Consequently, when fire strikes, men and machines are usually back in production quickly. Losses of vital materials are reduced to a minimum.

Industries guarding War-Winning Production with engineered Cardox Fire Extinguishing Systems include leading manufacturers of *Airplanes, Airplane Parts, Armor Plate, Aviation Carburetors, Aviation Engines, Cold Strip Steel, Electric Power, Engine Parts, Forgings, Motor Fuel Plastics, Processed Fabric, Rubber Products, Solvents, Tanks, Tank Engines.*

Today, the facilities of Cardox are concentrated on two activities: (1) Providing fire protection for War-Winning Production; (2) Applying the technological knowledge gained here to help industrial, municipal, state and national fire fighting organizations perfect plans to increase the efficiency of fire protection both today and after the war.

If more information would help—in solving your fire protection problems of today or tomorrow—write on your company letterhead for Bulletin 13113.

★ ★ ★

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS

District Offices in **New York • Washington Detroit • Cleveland • Atlanta • Pittsburgh San Francisco • Los Angeles • Seattle**

How Cardox Systems Protect War Industries

- Timed discharges, as needed, through built-in piping systems . . . supplied instantly from a single storage unit holding tons (if required) of liquid Cardox CO_2.
- Mass discharge of Cardox CO_2 "knocks out" fire, by . . .
- Reducing oxygen content of the atmosphere below the concentration necessary for combustion, and . . .
- Cooling combustibles and fire zone below ignition temperature . . .
- Extinguishing fire quickly and completely *without* damage from extinguishing medium.

CARDOX—CO_2 Systems with Enhanced Fire Extinguishing Performance

A. Uniformity of CO_2 characteristics.
B. Extinguishing medium with uniformly greater cooling effect.
C. Accurate projection of CO_2 through greater distances.
D. Timed discharges, as needed, through built-in piping systems . . . supplied quickly from a single tank holding tons of liquid Cardox CO_2.

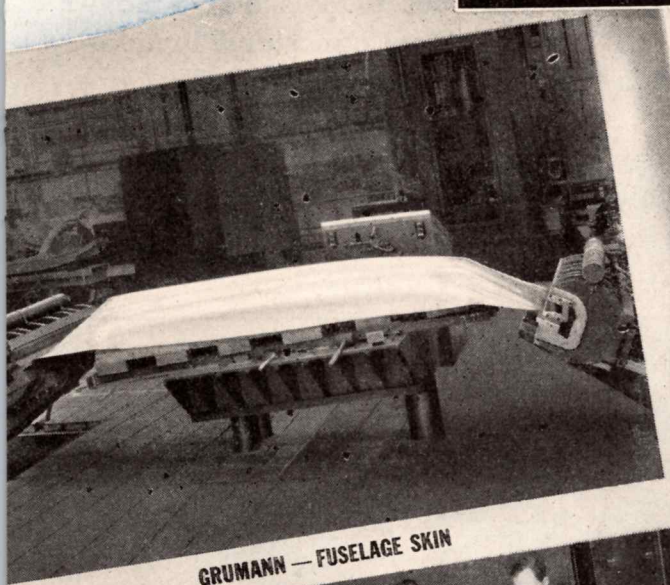
MASS DISCHARGE OF CO_2 · ENHANCED COOLING EFFECT · CENTRAL STORAGE UNIT · AMPLE CO_2 RESERVE · ENGINEERED SYSTEMS · MANUAL OR AUTOMATIC CONTROL

CARDOX

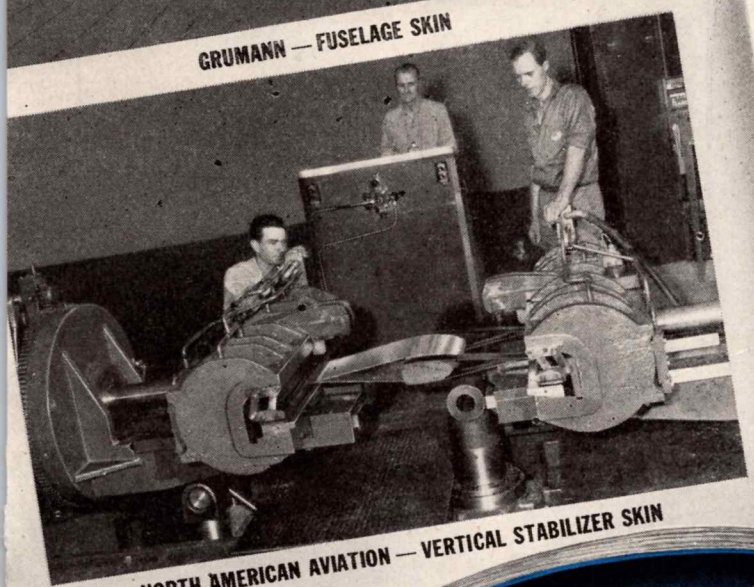
NON-DAMAGING FIRE EXTINGUISHING SYSTEMS

Versatility Unlimited

WITH SHERIDAN STRETCHERS

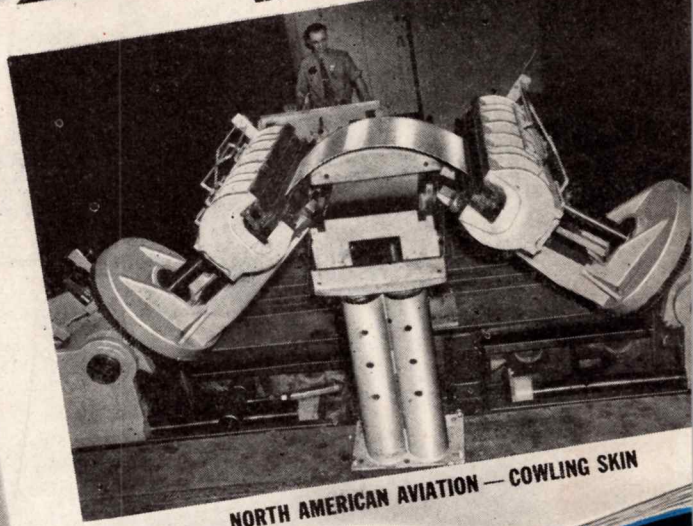


GRUMANN — FUSELAGE SKIN



NORTH AMERICAN AVIATION — VERTICAL STABILIZER SKIN

EDO — FLOAT BOTTOM



NORTH AMERICAN AVIATION — COWLING SKIN

These installations of SHERIDAN sheet stretchers in leading aircraft plants partially demonstrate the wide scope and versatility of these practical machines.

SHERIDAN makes the only hydraulically operated stretcher capable of handling flat sheets for longitudinal stretching up to a length of 22'3". Numerous unusual shapes in between that maximum (upper right photo) and small leading edge skins (lower left photo) can be formed.

There are also a number of SHERIDAN *extrusion* stretchers installed in aircraft plants producing extruded parts in a wide range of shapes and sizes.

Our engineering department will be glad to help you solve your metal forming problems.

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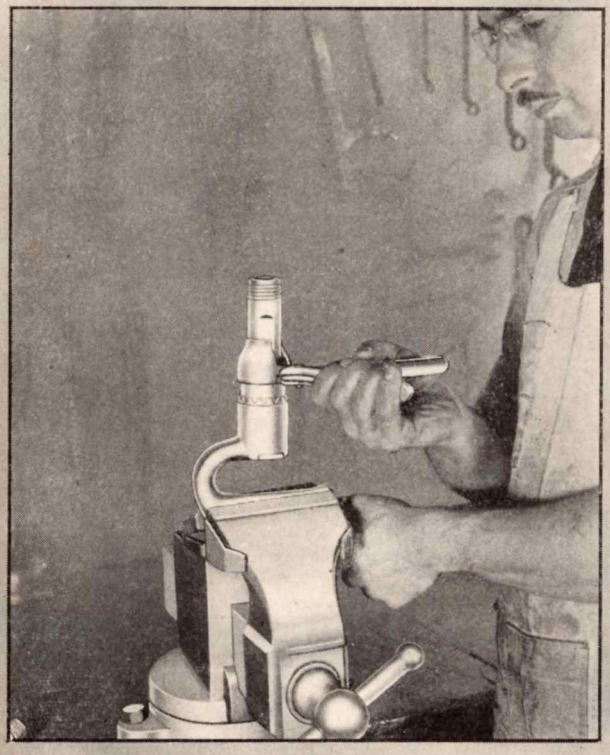
Courtesy of Pan-American World Airways

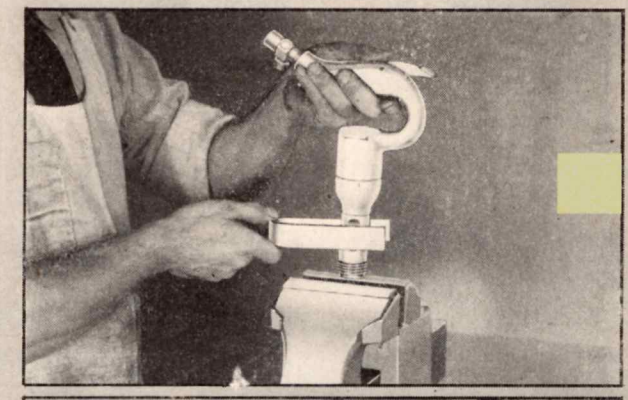
Service Them and They'll Serve You

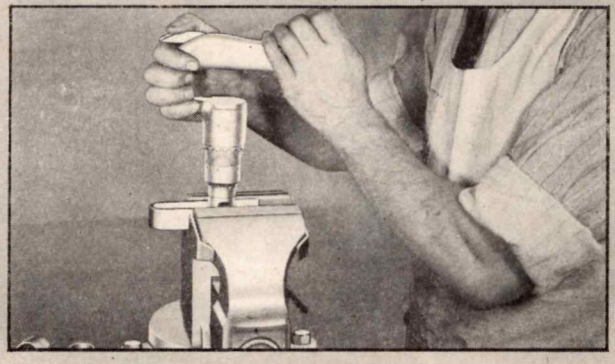
Today, it is vitally important for all tools to give maximum service. CP Aero Riveters can stand long arduous use with a minimum of maintenance. They are built to take it . . . But abuse is another thing. . . . Care for them. . . . Keep them clean. . . . Lubricate them regularly, and follow the simple maintenance steps outlined below.

HOW TO GET MAXIMUM PRODUCTION FROM YOUR CP AERO RIVETER



Always remove deflector clip with expansion pliers. Use of a screw driver will injure tool.





When clamping riveter in vise to remove the handle, use V-strap over flats of the cylinder.

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Making only Mounted Wheels and small Grinding Wheels—maintaining highest quality in spite of large quantities and rush orders—shipping them promptly. ***This is our job, our battlefield.***

With full WPB approval, we stopped making all large size grinding wheels and fixed our sights on wheels *3″ in diameter and under.*

We worked all around the clock, 24 hours a day, and in a short time were able to fill orders on time—And, our central location cuts time in transit. Today, there is no waiting. With the Army-Navy E at our masthead, we are going full speed ahead.

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Half a century of specialization has established our reputation as the Small Wheel People of the Abrasive Industry. You can bank on us.

TEST WHEEL FREE—To get acquainted with Chicago Wheels, let us send one postpaid. Tell us size wheel and material you wish to grind.

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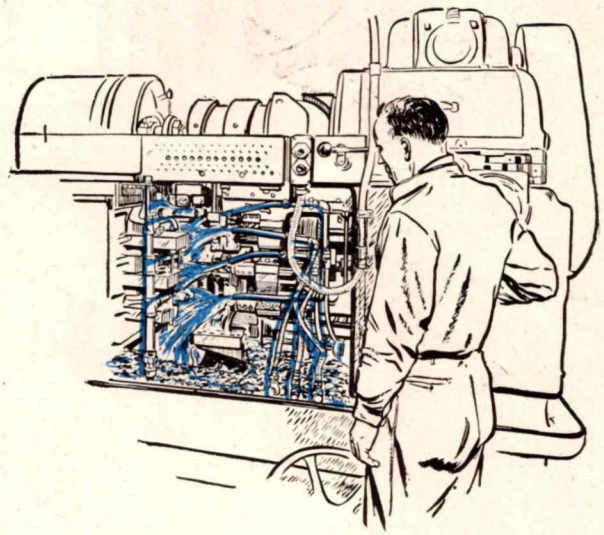

We Make No Other Claim Than This . . . "PERFECTED LUBEWELL" CUTTING COMPOUND WILL OUT-PERFORM ANY CUTTING OIL OR SOLUBLE EMULSION REGARDLESS OF THE MACHINE TOOL OR TYPE OF WORK BEING DONE

To prove this statement, G. Whitfield Richards will ship you any quantity of "Perfected Lubewell" and if you find that it does not: **1.** increase tool life up to 50%; **2.** increase production speed of the machine up to 25%; **3.** give a superior finish and hold to closer tolerances; **4.** lower cutting lubricant cost as much as 40%... you may tear up the bill. "Perfected Lubewell" is known from coast to coast as the one cutting compound for all machining operations, costing from 3 to 9 cents per gallon in the machine.

G. WHITFIELD RICHARDS

PIONEERS OF *Water Soluble Cutting and Drawing Lubricants*

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fulfilling exacting requirements for the

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Metal Specialty's plants are equipped to render you complete service in the fabrication of all Metal Parts, and in Plastic Injection Molding up through 18 ounces per shot. Along with 850-ton self-contained hydraulic presses for Metal Working, Metal Specialty has one of the four 18-36 ounce capacity injection presses for Custom Molding together with full complementary equipment.

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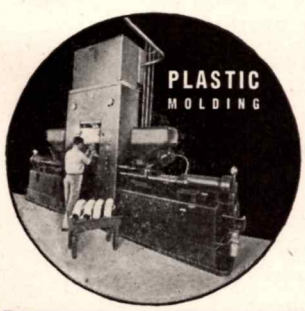
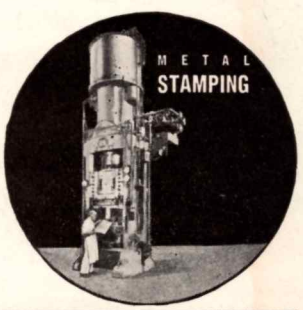
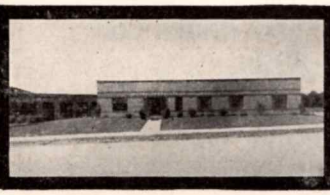
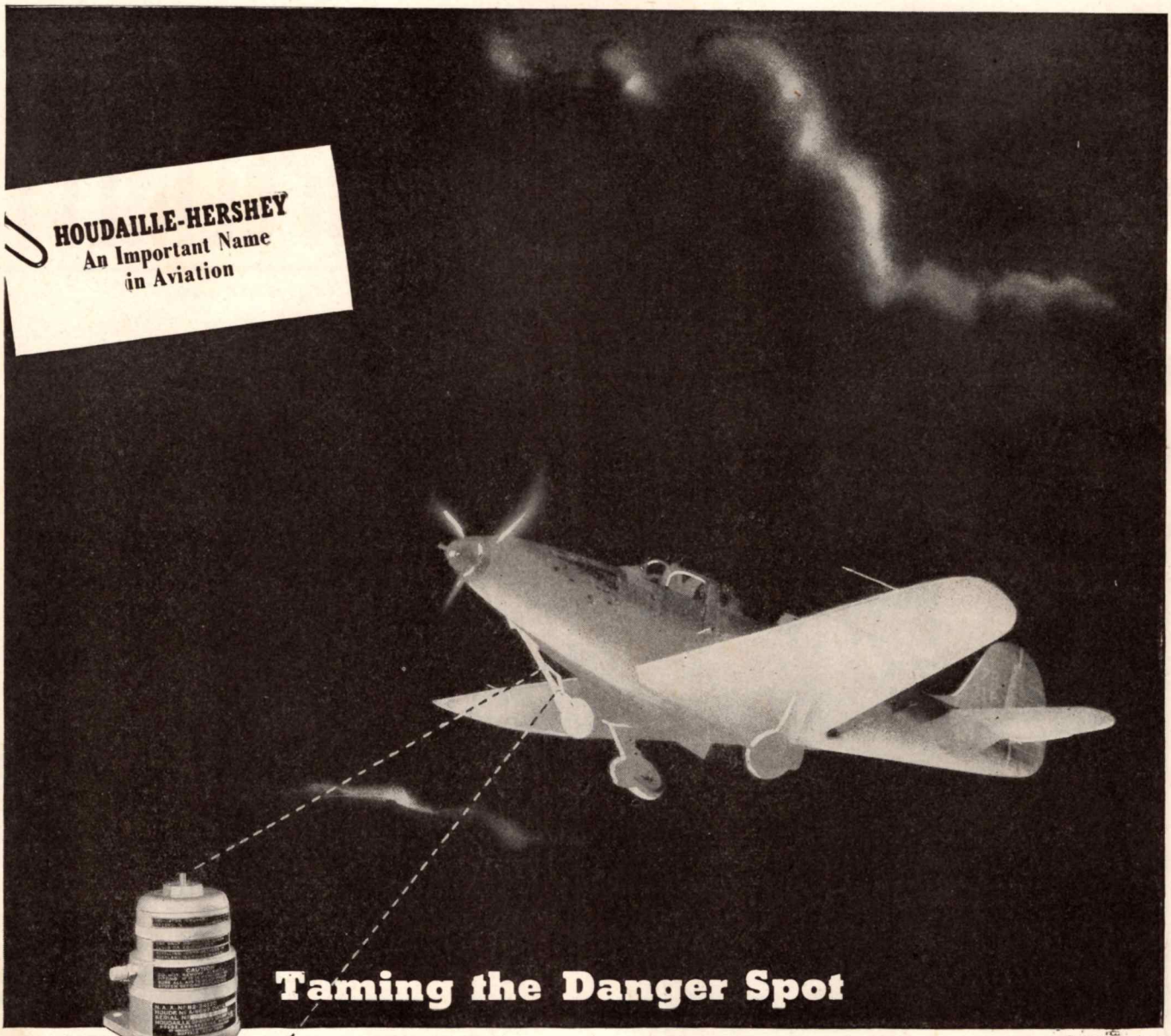




ARMY E NAVY



The
METAL SPECIALTY *Co.*
MAIN OFFICE AND PLANT • ESTE AVENUE • CINCINNATI, OHIO



Taming the Danger Spot

Bell Airacobra

The castering nose wheel on high speed fighters and heavy bombers alike can be a dangerous trouble-maker if uncontrolled.

Houdaille Hydraulic Shimmy Dampers provide ideal control of the shimmying forces which at times are of colossal magnitude—for they impose ever-increasing resistance as these forces mount yet offer little hindrance to slow wheel movements encountered in steering.

Behind these and other Houdaille aviation devices is more than a quarter-century of engineering experience.

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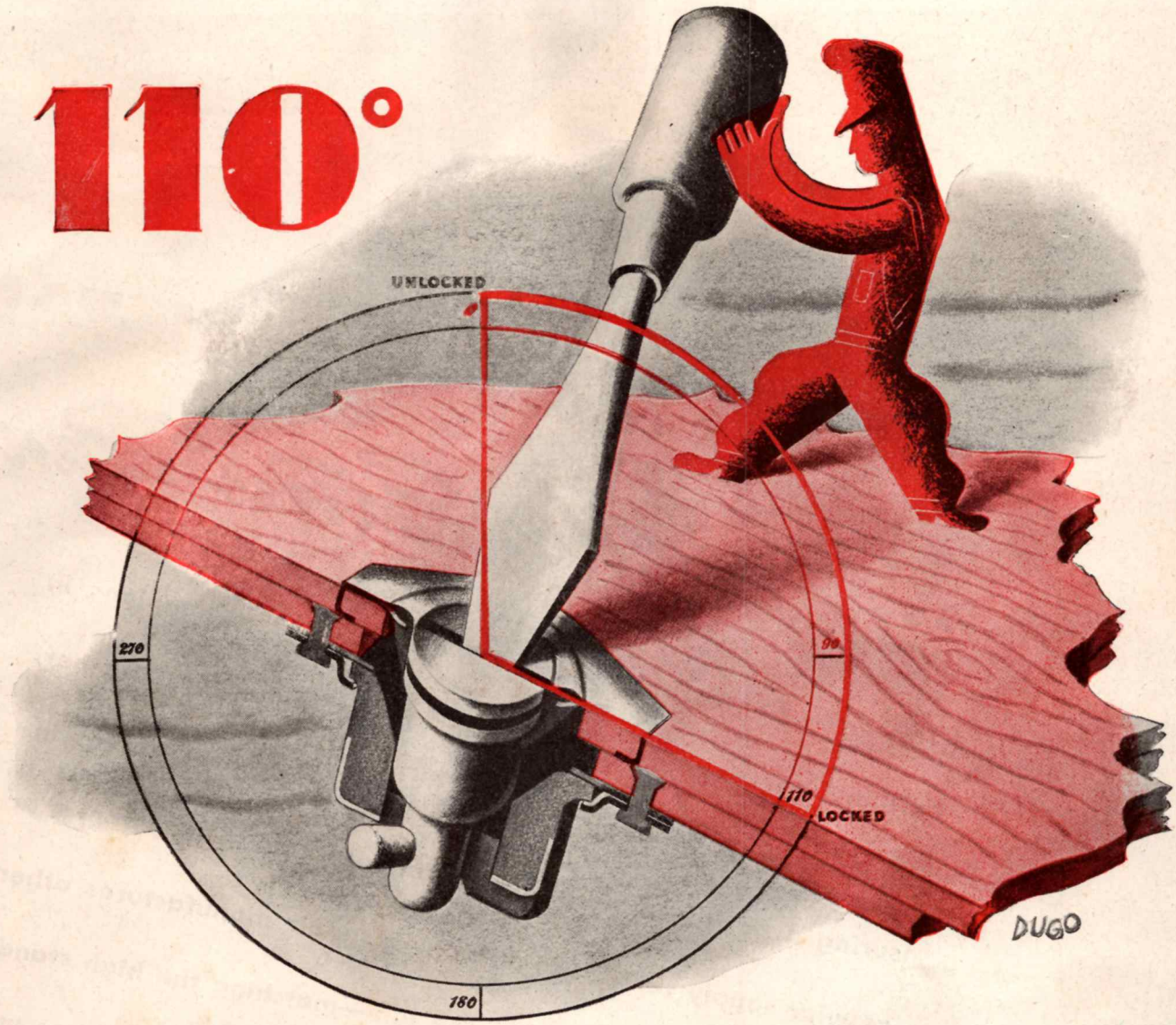


A short turn of the screw driver locks the Camloc Fastener as securely as bolt and nut yet without loss of time and parts. Reverse motion releases it. That is why millions of Camloc High Speed Fasteners on military aircraft make every vital part easily accessible. War production was quick to accept the High Speed Fastener as a necessity. Peacetime industries will be just as quick to sense Camloc's possibilities for safety, speed and economy. Write today for illustrated catalog CAMLOC FASTENER CORPORATION, 420 Lexington Avenue, New York 17, N. Y.

The Camloc Fastener is composed of three parts. A factory assembled Stud Assembly a Grommet for metal, plastic or plywood; a Cam Collar for single hole mounting or rivet type mounting —straight corner or floating The Floating Cam Collar allows up to 1/8" misalignment in any direction. All Camloc Fasteners carry complete Army and Navy approval.

CAMLOC *high-speed* FASTENERS

Copr. 1943, Camloc Fastener Corp

P-51 Mustang
STANDAIR FUEL TANK
...provides Extra Range
The P-47 Thunderbolt and the P-51 Mustang—champions in dishing out destruction—now are flying higher and farther, equipped with Standair Fuel Tank Pressure Control Valves insuring a positive flow of fuel from wing tanks, belly tanks, or regular supply tanks. In addition, Standair manufactures other instruments engineered for the job—matching the high standards of precision established by the U. S. Army Air Forces and leading aircraft manufacturers. Write or wire for specifi ns.
WAR BONDS put these fighters in the air. Keep them fighting with MORE BONDS!
P-47 Thunderbolt

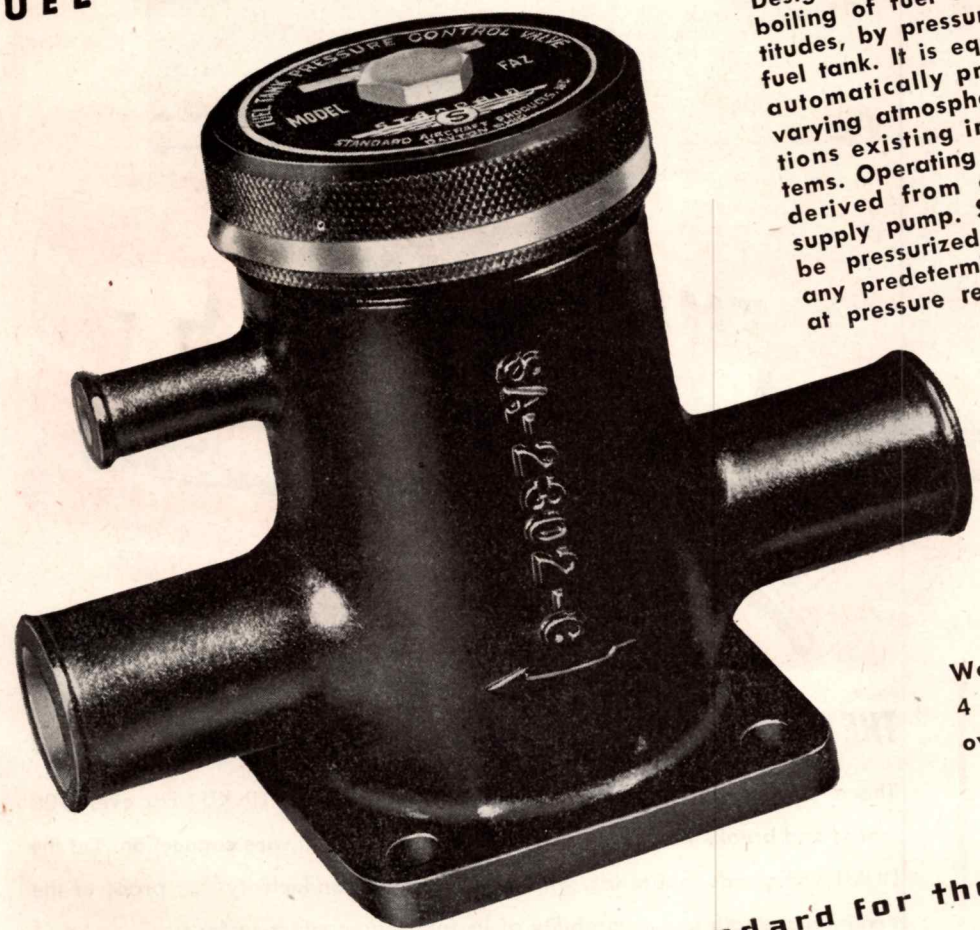
PRESSURE CONTROL VALVE

for these American Fighters

FUEL TANK PRESSURE CONTROL VALVE

Model FAZ

Designed to eliminate the boiling of fuel at high altitudes, by pressurizing the fuel tank. It is equipped to automatically provide for varying atmospheric conditions existing in fuel systems. Operating pressure is derived from exhaust of supply pump. Systems can be pressurized starting at any predetermined altitude at pressure required.



Weight 1 lb. 2 oz.
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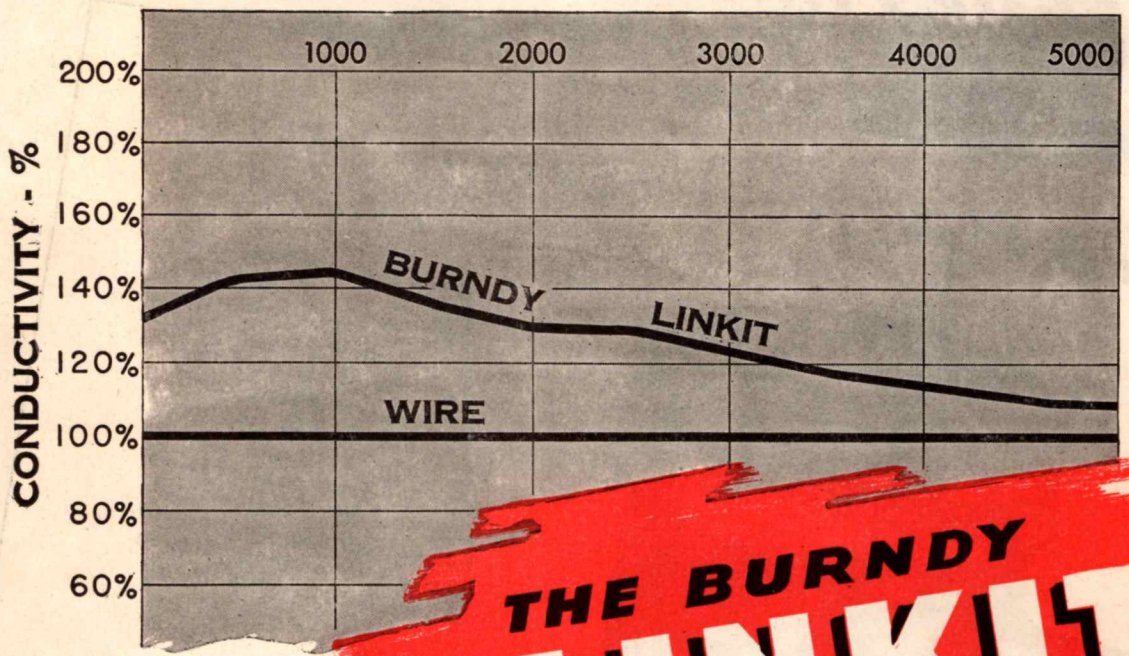
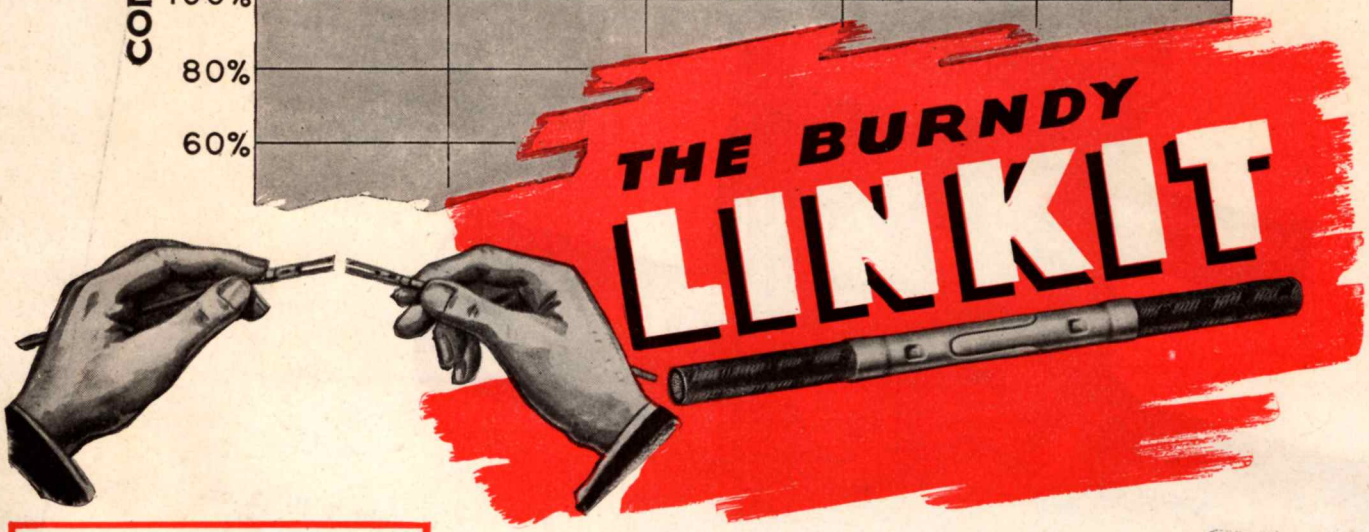
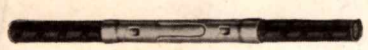
After 5000 makes and breaks

RELATIVE WIRE CONDUCTIVITY is still 110%!

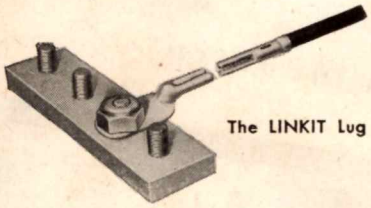




Patent No. 2,109,837



The Burndy LINKIT



The LINKIT Lug

LINKET with Burndy
Versiflex insulating sleeve

THE DETACHABLE CONNECTOR WITH NO LOOSE PARTS!

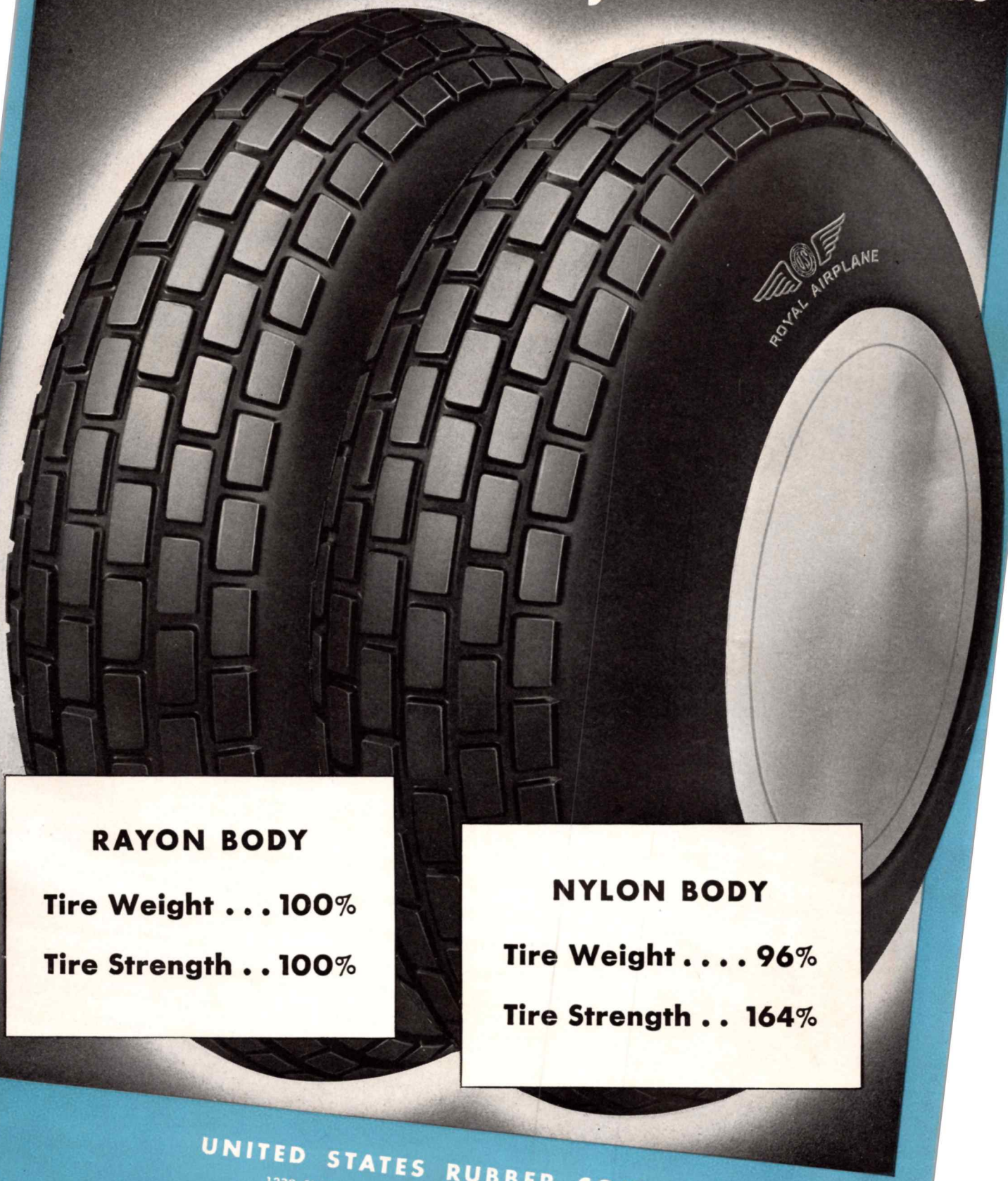
This is the test that wins *instant approval* for the Burndy LINKIT! For even 100 makes and breaks would be *extreme service* for a small wire connection. Yet the LINKIT withstands *thousands*, with little effect on conductivity . . . proof of the *enduring strength* and *wearability* of its four *long* contact surfaces.

Remember, too, that each half of the LINKIT is identical . . . and there are no extra parts to loosen or lose. The halves are quickly and securely indented to the wires with Burndy HYTOOLS in the usual way. LINKITS and LINKIT lugs are available for all wire sizes from #22 up. Literature gladly sent on request.

BURNDY ENGINEERING CO., INC., 107 Eastern Blvd., New York 54, N.Y.

BURNDY *Headquarters for Connectors*

How LIGHTER airplane tires carry HEAVIER loads



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Tire Weight . . . 100%

Tire Strength . . 100%

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Tire Weight 96%

Tire Strength . . 164%

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These Four Great War Planes

Tires Now Carry

HOW "U. S." TIRE ENGINEERS ANSWERED THE NEED FOR TIRES THAT CAN

P-39 Bell Airacobra—From its first, dramatic introduction in 1940, the P-39 with its tank-destroying 37mm. cannon has been among the fighting favorites of our Army Air Forces and those of our Allies. It has proved its fighting power in the Aleutians, the South Pacific, North Africa, Russia—in every theater of the war. When first produced, its rated gross weight was about 6000 pounds.

Today with heavy machine guns replacing light, with bullet-sealing fuel cells instead of aluminum tanks, with greater stores of gas and ammunition and added plane and pilot armor, this fighter today weighs 7404 pounds.

But the same size tire, 26 x 6, had to carry the load. Tires with cotton cord bodies would not do the job. "U.S." tire engineers, who pioneered rayon cord tires with the Army and Navy air arms, *decreased* tire weight, added the stamina needed to carry a third more weight—without adding even a fraction of an inch to the over-all tire size.

P-40 Curtiss Warhawk—The record of the "Flying Tigers" knocking ten enemy planes out of the sky to one Warhawk lost, added to distinguished performance in every theater of the war, entitles the Warhawk to a place in the front line of America's great war planes.

Armed at first with but two machine guns firing through the propeller, today's P-40 carries six heavy guns, a thousand-pound bomb load and heavier armor protection for the plane and pilot. Bullet-sealing fuel cells, heavier, more powerful engines and super-chargers, along with other new equipment, have raised the 1940 weight of 6789 pounds to 9000 pounds today.

The 30" tire size that carried the original weight has been engineered to carry this increased load at higher landing speeds. Again, lighter U.S. Royal Rayon Cord tires replaced heavier cotton tires that could not shoulder the load. And not one fraction of an inch was added to the over-all tire size.

UNITED STATES

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As Much As 50% More Weight

TAKE THE INCREASED WAR LOAD . . . WITHOUT INCREASING TIRE SIZE

B-24 Consolidated Liberator — Over the Ploesti oil fields and the railway yards of Rome, over every Axis center of war activity, the Consolidated Liberator has made the might of American air power felt with devastating effect.

In 1940, the B-24 was rated at 41,000 gross weight. Today, published figures rate it at 65,000 pounds, an increase of over 50%. From a half-dozen machine guns to a complement of over a dozen with four power turrets, from aluminum gas tanks to bullet-sealing fuel cells and with ten tons of bombs, this great bomber has grown into one of the most potent offensive weapons of the United Nations.

Even with a 50% increase in load, the 56″ tire size that equipped the original Liberator still does the job. Lighter, U.S. Royal Rayons replaced heavier, bulkier cotton cords. And today, more "muscle," more strength to carry the thirty-ton load is built into new Nylon tires supplied in large quantity by "U.S." to the Army Air Force.

B-17 Boeing Flying Fortress — The very words, Flying Fortress, have become the symbol of deadly, long-range bombing power. The achievements of the Fortress and its heroic crews in precision bombing have earned it a distinguished place in the history of World War II.

In 1940, the rated gross weight of the Flying Fortress was 45,470 pounds. Today with thirteen heavy guns, with bullet-sealing fuel cells carrying long-range supplies of gas, with ten tons of bomb load, the Fortress weighs approximately 65,000 pounds—an increase of over 45%!

In 1940, the Fortress landed its 45,000 pounds on 19.00 x 23 tires. Today, with 65,000 pounds and more, the tire size has been increased only slightly. "U.S." tire engineers first built tires with rayon bodies as gross weight increased. They carried the load over rough landing fields at higher and higher speeds. Then came U.S. Royals with Nylon bodies delivering 64% more strength than rayon tires!

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U. S. ROYAL SMOOTH CONTOUR BLOCK TREAD—The sharp edges of the U.S. Royal Block Tread protect against either forward or lateral skids.

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The U.S. Royal line is complete with tires and tubes for landing wheels, nose wheels and tail wheels. Static Conductor Construction is available in all types.

If you have not used U.S. Royal Static Conductor tires on your planes, write us for complete information today. Your nearest "U.S." Field Airplane Tire Engineer, whose time is spent exclusively on airplane tire and tube developments, will gladly work with you on this or any other airplane tire problem.

UNITED STATES RUBBER COMPANY

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Battery of Type "D" Mult-Au-Matics in a large airplane engine plant, machining cylinder barrels.

PRODUCTION "Line of Battle"

Two urgent demands, from this all-out war, have brought into being many batteries of Bullard Mult-Au-Matics like the one shown here: The demand for production in overwhelming volume. And, no less important, the demand for the uncompromising accuracy which gives to airplane engines their fighting edge.

Since Mult-Au-Matic production is continuous production . . . since accuracy that meets fine-tolerance standards is built into its sturdy construction . . . and since the Mult-Au-Matic delivers both these essentials at marked savings of man-power and floorspace, the Mult-Au-Matic is the natural choice for scores of urgent war jobs.

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And when peace is won—a little time for retooling, and they'll contribute this same volume-with-precision to important new tasks.

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CHASE HAS PROVIDED UPHOLSTERY, LINING AND DRAPES FOR EVERY FORM OF PASSENGER TRANSPORT SINCE THE EARLY DAYS OF . . .

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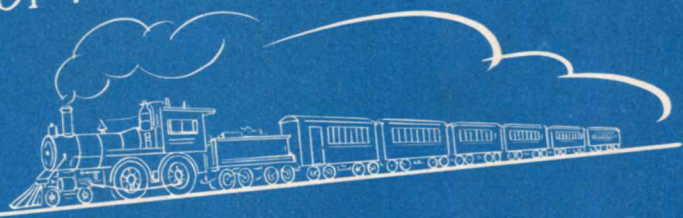
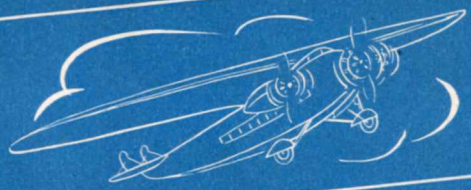


THE "HORSELESS CARRIAGE"

THE MOTOR COACH



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TODAY WE SOLICIT THE OPPORTUNITY TO DEVELOP SPECIAL CHASE VELMO UPHOLSTERY, CHASE SANVALE FABRICS, OR CHASE REDOLITE COATED FABRICS FOR YOUR POST-WAR PLANES.

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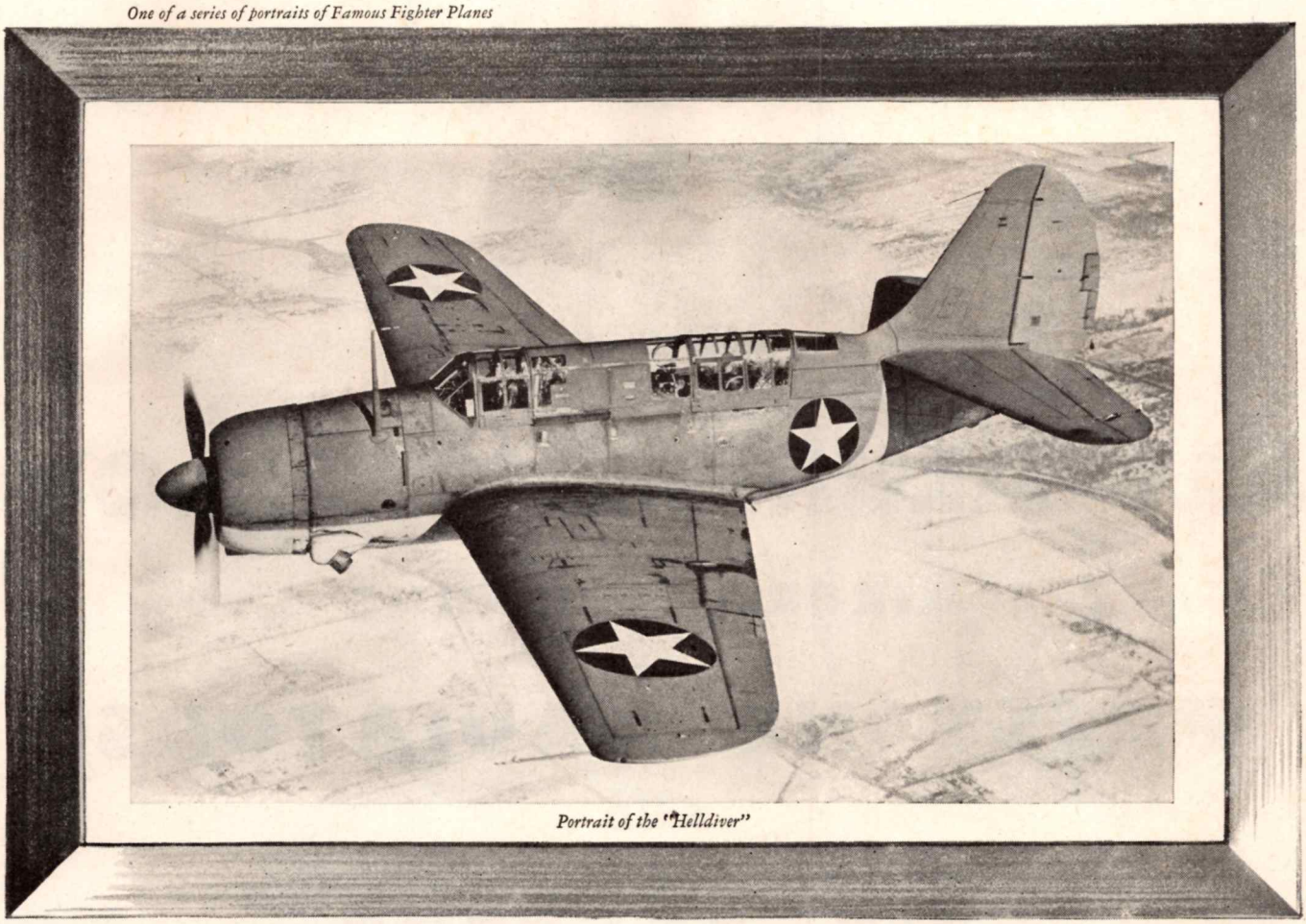
One of a series of portraits of Famous Fighter Planes



Portrait of the "Helldiver"

WHEN THE "HELLDIVER" MEETS THE SONS OF HEAVEN

... Macwhyte Control Cables Will Be Present Carrying heavier bomb loads faster, further, this Curtiss ship is control-equipped with Macwhyte "Hi-Fatigue" Aircraft Cables.

No welcome sight to our enemies is the appearance of the Curtiss SB2C-1... better known as the "Helldiver". A two-place mid-wing monoplane normally used for naval dive bombing, the "Helldiver" is designed to be used on scout observation missions operating from aircraft carriers.

The strain and stress on dive bomber cables is obviously great, but Macwhyte Cables have the flexibility and strength to meet such unusual demands at any time. We're glad that these products are proving useful on the "Helldiver".

ARMY NAVY

"Awarded for outstanding achievement to the men and women of Macwhyte Co."

MACWHYTE COMPANY, 2907 Fourteenth Avenue, Kenosha, Wis. Manufacturers of "Hi-Fatigue" Aircraft Cable, "Safe-Lock" Cable Terminals, Aircraft Tie-Rods, Braided Wire Rope Slings, and Wire Rope for all requirements.

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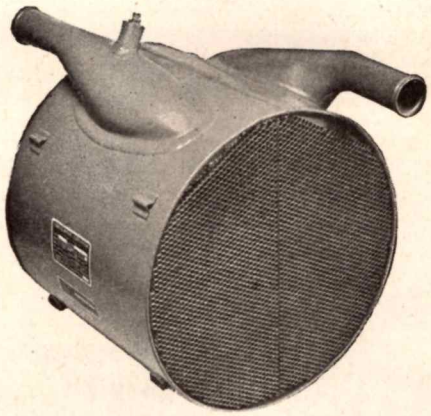

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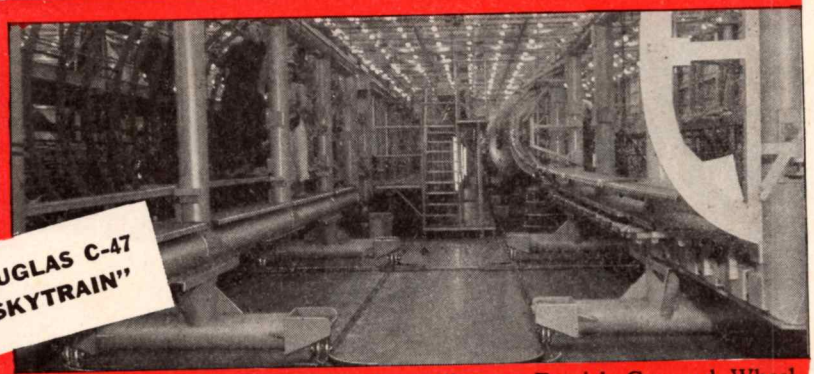
Douglas

GIVES "WINGS" TO PRODUCTION ON BASSICK GROOVED WHEEL CASTERS

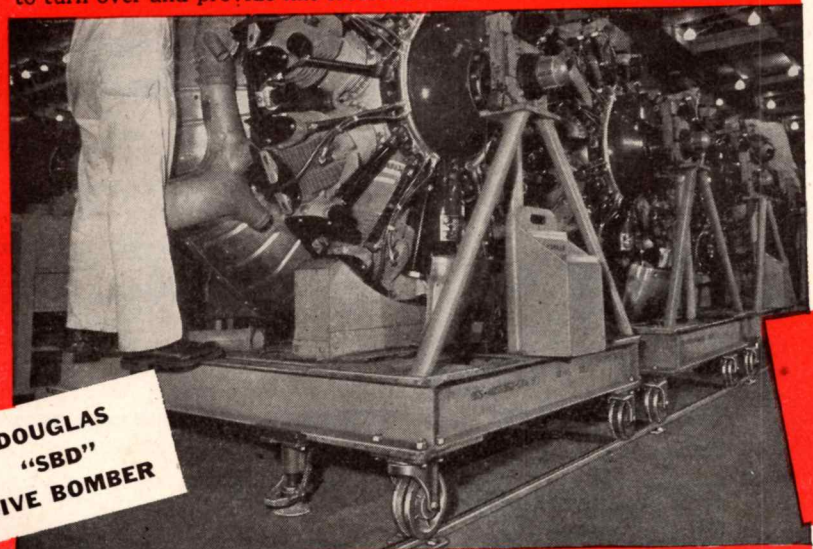


DOUGLAS C-47 "SKYTRAIN"

Fuselage top section assembly jigs rolling on Bassick Grooved Wheel Casters and angle iron floor track. (Notice crossover switches)

DOUGLAS C-47 "SKYTRAIN"

Being rolled on angle track assembly line to flight ramp. Ship is carried on "Skate Dollies" equipped with Bassick Casters. Track sections are hinged to turn over and provide flat crossover area when not in use.

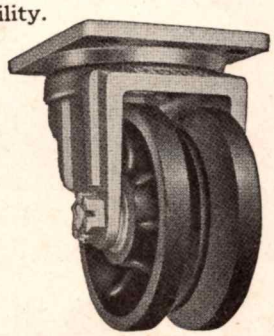


DOUGLAS "SBD" DIVE BOMBER

Engine line set up on Bassick Grooved Wheel Casters. Bassick Position Locks hold engine stand securely in place when movement is not desired.

★ ★ ★ ★ ★

GROOVED WHEEL CASTERS operating on angle floor track, help to develop an assembly line with flexible mobility.



THE Douglas plants throughout the country have achieved an outstanding record for meeting and beating schedules in the production of combat and transport planes. Douglas engineers have made excellent use of Bassick grooved wheel casters.

Bassick precision-built casters are speeding the "take off" of new war planes in almost every major aircraft plant. They add flexibility to the handling of materials of all types. Bassick grooved wheel casters are made in 4", 6", 8" and 10" sizes.

When you need casters, look to Bassick — the world's largest manufacturer — for the right size and type.

★ "Keep Production Rolling Easy and Fast With Casters by Bassick Designed for the Task"

Bassick

MAKING MORE KINDS OF CASTERS ...MAKING CASTERS DO MORE

THE BASSICK COMPANY
BRIDGEPORT, CONN.
Division of Stewart-Warner Corp., Chicago, Ill.
Canadian Factory: Stewart-Warner-Alemite Corporation of Canada, Ltd., Belleville, Ont.

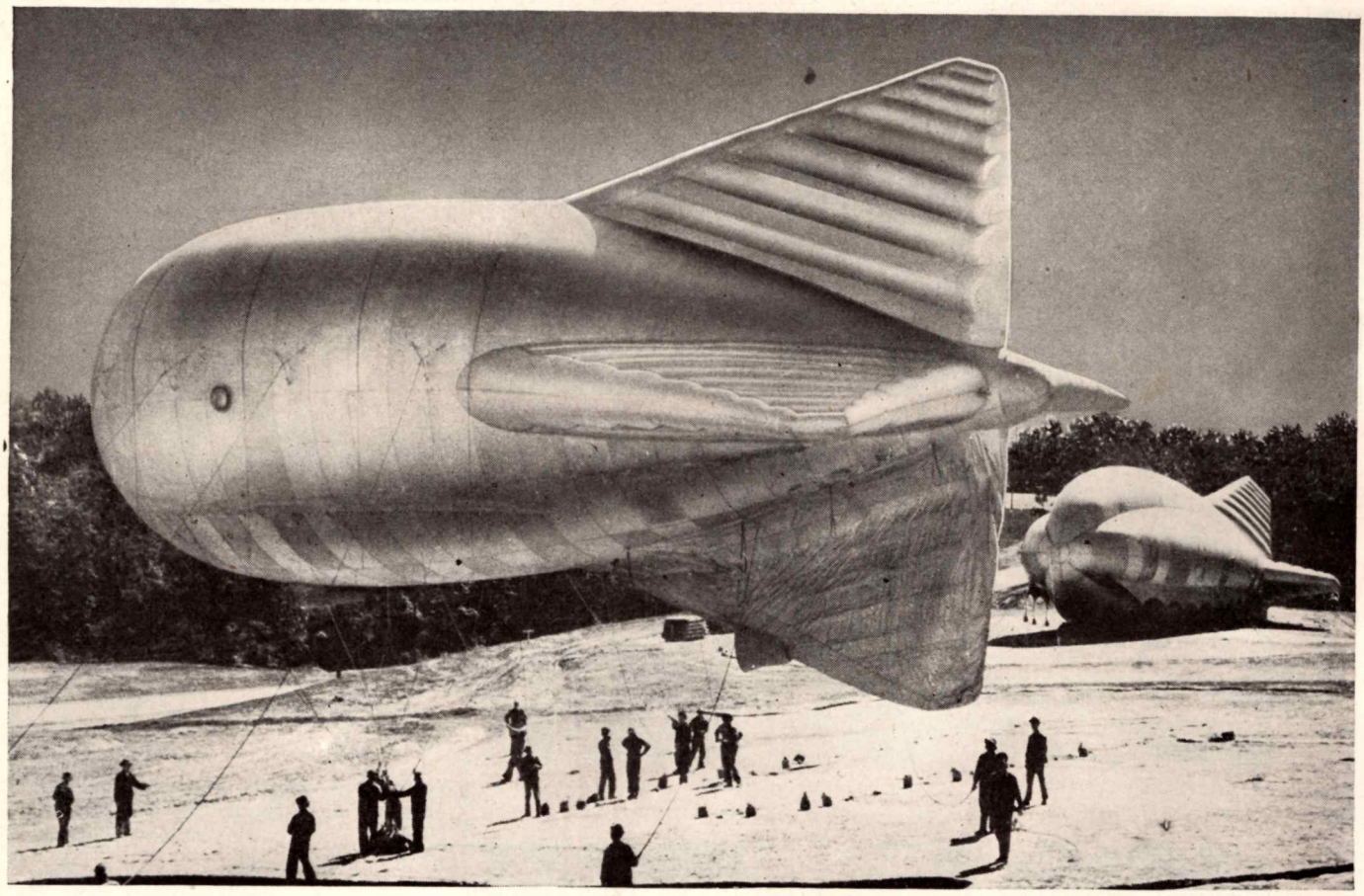
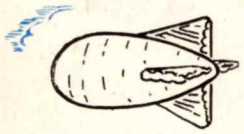


Photo by Acme

WE'RE RATHER PROUD!



Yes, we're rather proud that we have been able to provide one of our adhesives for successfully bonding the seams in barrage balloons, those enormous cigar-shaped bags which have been protecting our own coastlines, as well as the landing barges which we are now using to invade enemy territory. We're glad to have been able to help in that specific problem, and we're eager to help in the other adhesive requirements of the aircraft industry. The combined abilities of our technicians, together with years of experience in the compounding of rubber and synthetic-rubber adhesives, are available to all manufacturers of airplane equipment wherever a cement is needed to complete the job.

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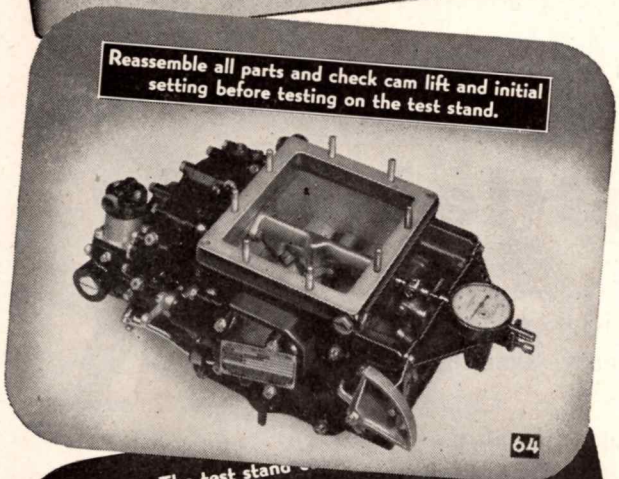
In Slide Films and Book



Visual education is a vital part of our war program. Many training centers are finding these two new Holley educational aids essential in their carburetor instruction work.

This material is available in two forms . . . in a series of eleven 35-mm. strip slide films, and in a 96-page book for review purposes.

This film library and book both contain the same illustrations and descriptive matter . . . complete information on every detail of Holley Aircraft Carburetor operation and servicing.

Write for further information.

HOLLEY CARBURETOR CO.
DETROIT, MICHIGAN

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Giant in a bottle!

Compressed in a handy cylinder, ready to go to work at an instant's notice, lives a mighty giant—named Carbon Dioxide. A container only 3 7/16 by 9 1/8 inches holds 42,000 foot-pounds of energy—available at the turn of a valve!

Walter Kidde & Company has developed many interesting applications for this gas-under-pressure. In the aviation industry, it's serving as a source of emergency power when the hydraulic system is crippled in combat. It opens bomb-bay doors, lowers landing wheels, powers the brakes.

If you have a problem in power actuation, carbon dioxide may be your solution. Kidde engineers can help you design cylinders, valves, release mechanisms, etc., to harness this high-pressure gas to the job you want done. Just drop a line to our Research and Development Department.

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WALDES TRUARC presents a significant advance in retaining rings. It spreads or contracts without distortion; always retaining its perfectly fitting circular contour.

For thrust-load fixing, and shaft and housing applications, Waldes Truarc provides distinct advantages over nuts and bolts or wedges and washers... it reduces dimension and weight ...saves material...cuts manufacturing time... simplifies assembly and dis-assembly.

On request, we will gladly furnish samples and full data for your tests.

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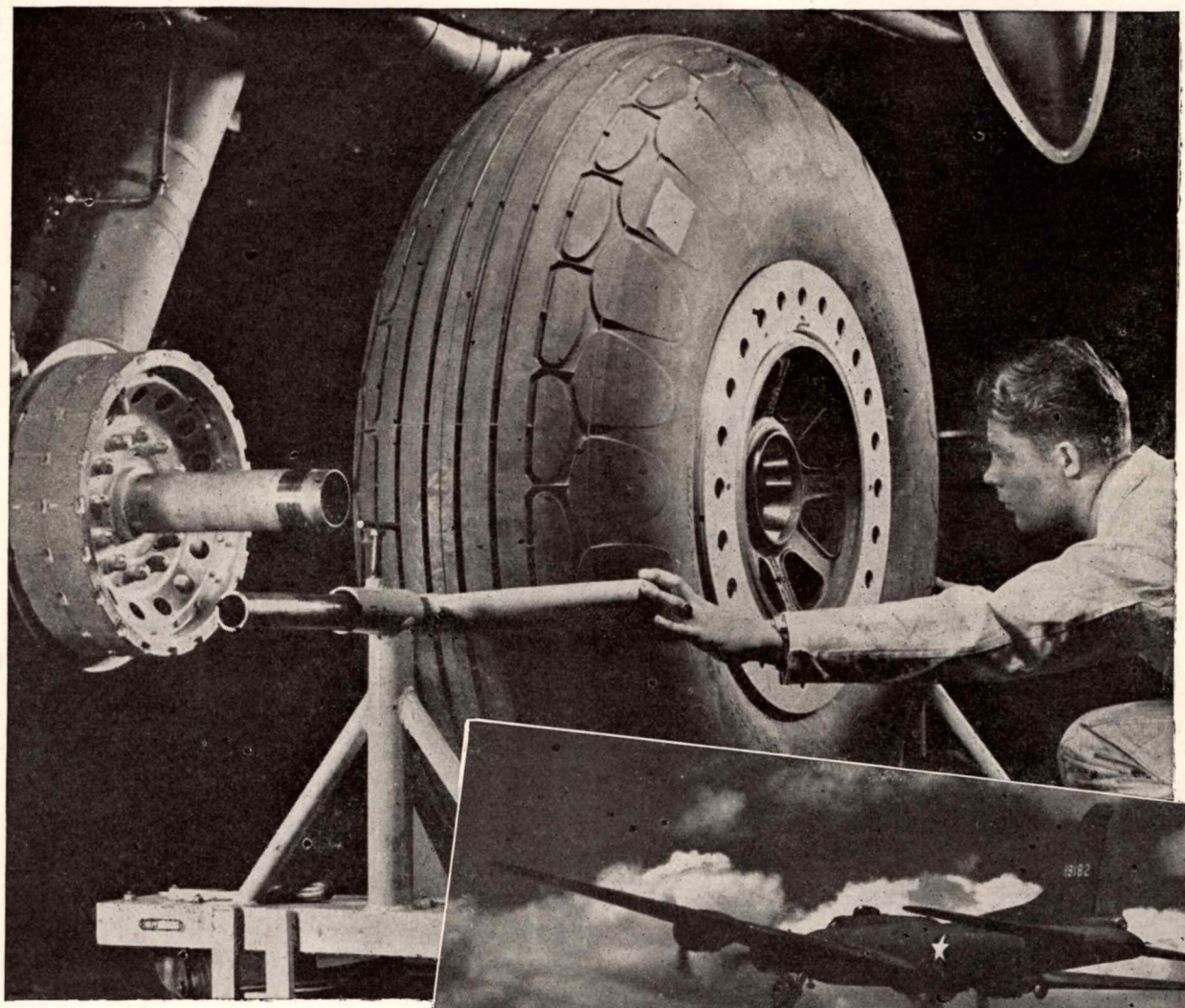
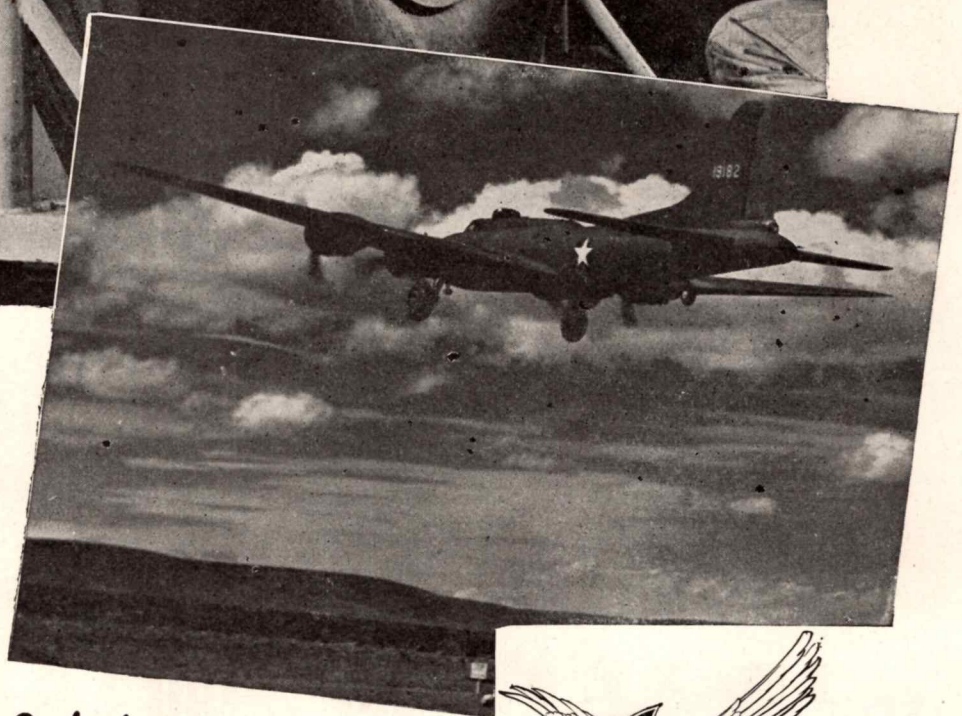


B-17 Factory and Flight Photos from Boeing Aircraft Co.



Easy does it

says

Boeing . . .

Easy does it

says the Pilot

From factory to field to sky—"easy" is the word for assembly, maintenance and landings with Hayes Wheels and Brakes.

On Boeing Flying Fortress and Consolidated Liberator —on every U. S. 4-engine bomber, as on thousands of other Army and Navy fighting and training planes, on air transport and airline ships—you'll find Hayes equipment the standard for accurate ground control.

Representatives: { Western: Airsupply Co., 5959 W. 3rd St., Los Angeles
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"Getting on top of the job" applies literally to battle in the air. The plane with the highest critical altitude usually wins . . . and it is the specific job of Bush Intercoolers to provide superior critical altitudes for warplanes of the United Nations. This experience . . . specialized in the heat transfer field and applied to the hundreds of commercial and industrial applications which will become available when the war is won . . . will one day help many a business to "get on top of the job." BUY WAR BONDS.

BUSH MANUFACTURING CO. HARTFORD CONNECTICUT

She can handle

MORE MAN-SIZE JOBS

with **ARO** *Pneumatic Tools*

Gear your production to greater *speed* and *efficiency*...by using ARO Pneumatic Tools for all types of small tool jobs such as drilling, grinding, screw-driving, nut-setting, and many special applications.

Because of light weight in relation to great power ARO Tools are easy-to-handle for women employees resulting in more work done and less fatigue.

Today's demands for continuous round-the-clock production emphasize the importance of ARO's simple design and outstanding dependability.

Immediate delivery of repair parts and excellent field service. Write for catalog. The Aro Equipment Corporation, Bryan, Ohio.

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THE ARO EQUIP. CORP.
PNEUMATIC ARO TOOLS
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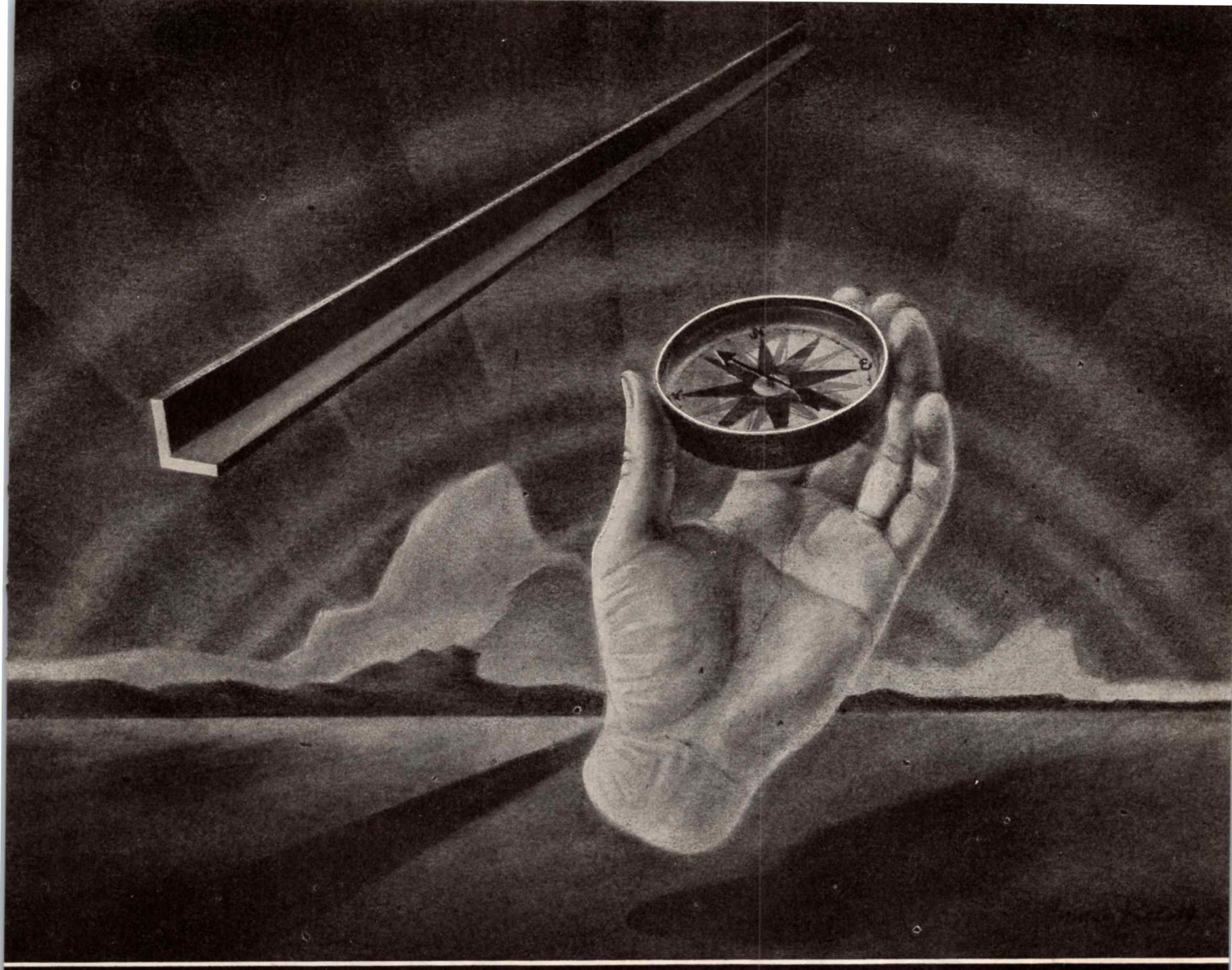
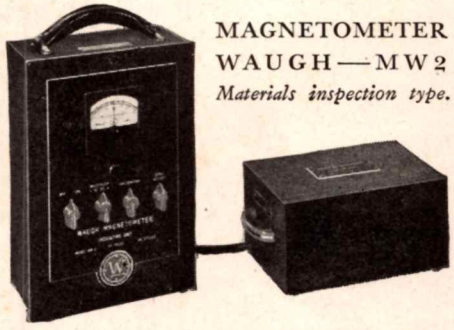


When a compass will not show you the way to go home

RESIDUAL MAGNETISM, in plane parts and members, too often causes compass deflections that set a pilot off his course. Magnetic fields, to be properly dealt with, must be measured—their effects at compass locations accurately determined.

WAUGH MAGNETOMETERS provide a practical means for measuring residual magnetic fields accurately and instantaneously. Deflections can be read in milligausses or degrees. Polarity is also indicated. MODEL MW-2 is for inspection of airplane materials and parts. MODEL MW-3, especially fitted for use in checking compasses in completed planes, speeds and simplifies the important operation of swinging planes on the compass rose. MODEL MW-4 has a miniature pick-up unit that can be substituted for the compass in the instrument panel.

Send for descriptive literature.



MAGNETOMETER
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WAUGH *Laboratories*

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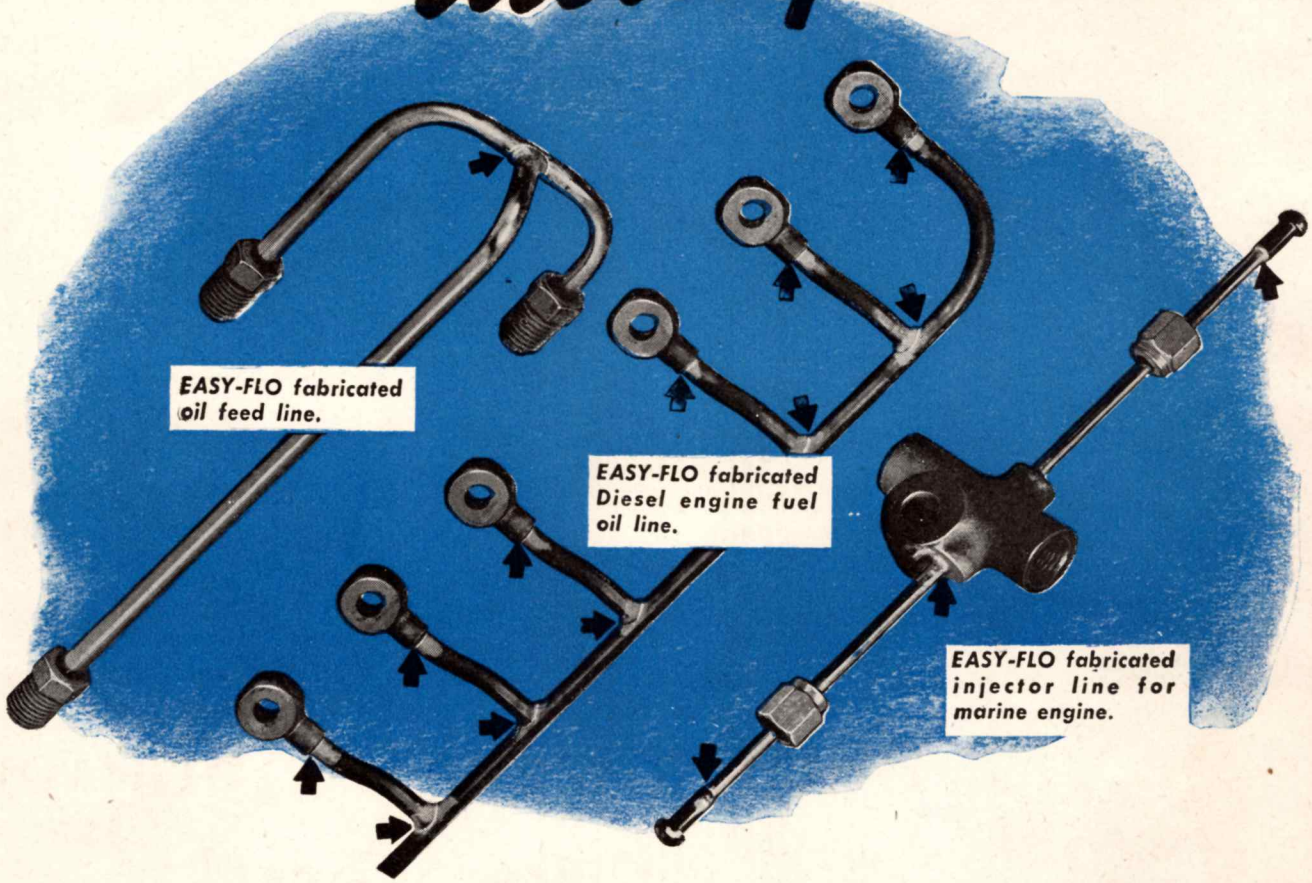
WHENEVER *tubing* IS INVOLVED



it will pay you to design for and specify SIL-FOS or EASY-FLO brazing

It will pay because these two low-temperature silver brazing alloys meet every requirement of ferrous and non-ferrous tubing fabrication. They make air, gas and liquid-tight joints with consistent reliability and unequaled speed—joints with the strength and ductility to withstand severe vibration, shock and temperature changes—joints that are high in resistance to most corrosive agents. And they do all this at surprisingly low cost.

Three typical BUNDY TUBING jobs are shown above—all fabricated with EASY-FLO—and all done by girl operators, for it's easy to braze with these exceptionally free-flowing alloys.

BULLETIN 12-A GIVES YOU THE FULL SIL-FOS AND EASY-FLO STORY and much useful metal joining information. Write for your copy now.

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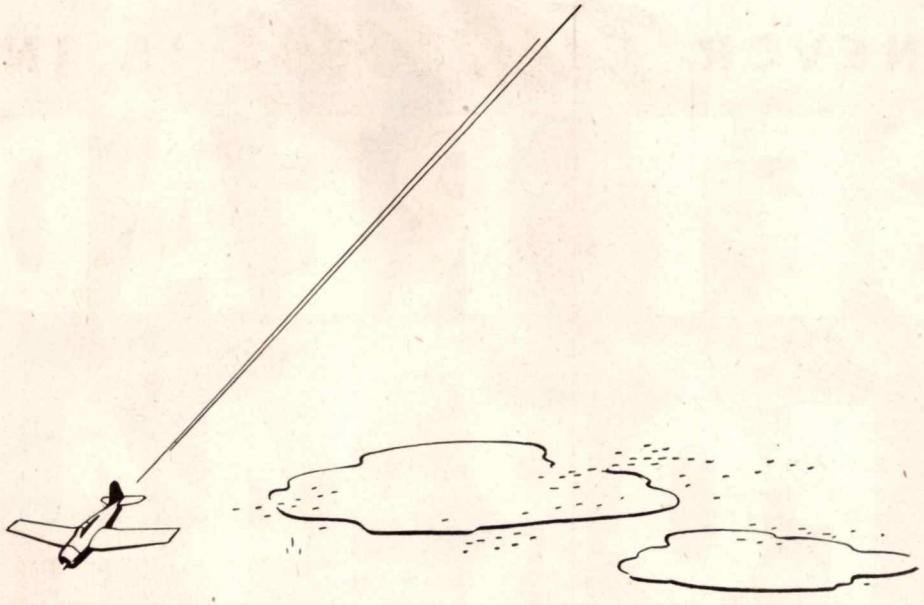

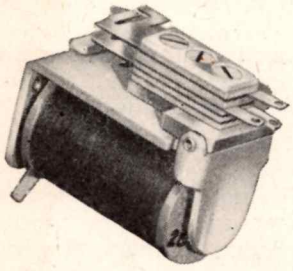

Built to take vibration at its worst!

THERE is no tougher test for any relay than the vibration set up by a power dive. Yet Automatic Electric's Class "S" Relays take the worst beating that this service can give, and come through with a safe margin to spare.

These tiny but powerful relays have been specially designed to meet the tough conditions of modern flying. Light weight and small size are only part of the story. Even more important are these features:

1. Vibration resistance is no after-thought with Class "S" Relays — it's built in. It surpasses the most rigorous tests required by the Signal Corps and the Air Forces.

2. Unique spring design provides high contact pressure within small space limits.

3. Twin contacts provide added assurance of reliability.

4. Newly designed pin-pivoted armature with full-length bearing results in exceptionally long life, even under the toughest conditions.

Before specifying relays for use on aircraft or for other applications where small size, light weight and dependability are important, get the facts on Class "S". Write for circular.

AUTOMATIC ELECTRIC SALES CORPORATION
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Relays
AND OTHER CONTROL DEVICES
by AUTOMATIC ELECTRIC

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

GET READY FOR '44!

Post-war planning will largely depend on the records you keep today. Those records *must* be kept accurate ... *and immediately available* at all times! As records grow ... and *how* they do in these war times ... *they must be housed properly!*

No longer need your file operators struggle along with inadequate, makeshift filing equipment! Their speed and accuracy can now be greatly increased by the addition of a few new GUARDSMAN wood files.

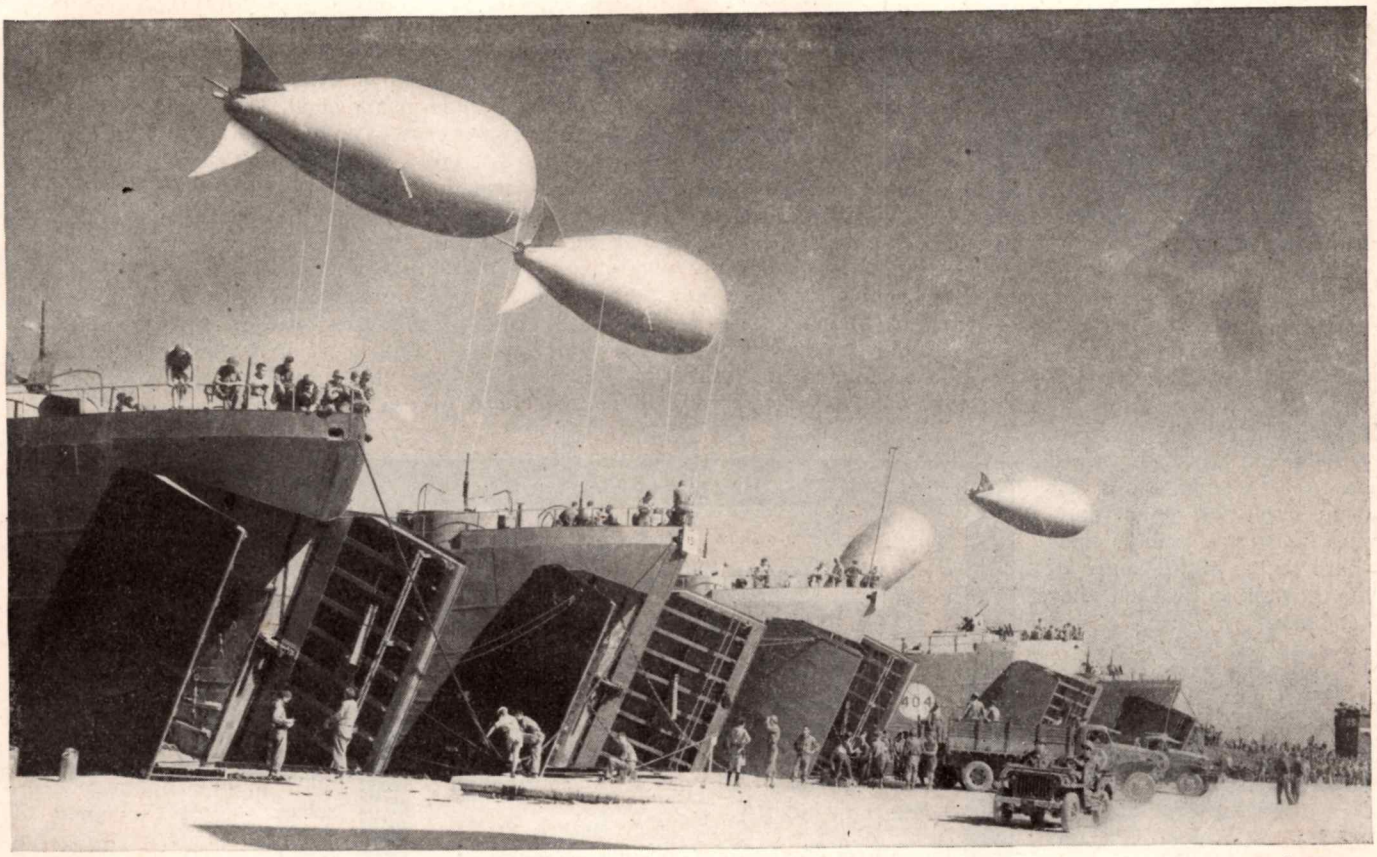
IMMEDIATE DELIVERY of GUARDSMAN Filing Cabinets

Yes, *now!* ... for GUARDSMAN cabinets are ready for *immediate delivery* ... without priority! Not just in four or five styles but in *every type* and size ... and they look exactly like steel cabinets. We have on hand *the world's most complete* line of wood filing cabinets ... priced *right* to provide amazingly low cost per filing inch!

The GUARDSMAN is not a "substitute for the duration"! Ingenious construction details have made this a product of skilled craftsmanship ... built for many years of trouble-free performance. Small wonder that hundreds of business concerns have chosen GUARDSMAN after exhaustive *competitive* tests.

Call our nearest branch office today and tell them when you'd like your files delivered. Or, if you prefer fuller information, write for your free copy of "Filing Equipment in Wood"—a complete description of GUARDSMAN in every style.

REMINGTON RAND
BUFFALO 3, NEW YORK



Acme

Balloons guard LST boats (landing-ship tanks) about to take aboard a division of infantry soldiers for whom American industry is already planning jobs after the war

FROM UNIFORMS TO WHAT?

HENRY J. TAYLOR

IN the confused discussions about who is to supply post-war jobs, the government or the people's own enterprises, the words imply a choice where there is no *long term* choice. The government does not, and cannot, supply jobs—any more than the nozzle of a hose supplies water.

If this truism seems uncompromising, it is only for the purpose of establishing a fundamental approach to a better discussion, without getting bogged down in the obvious ability of any central government spending agency to hire people at the expense of other citizens, and to commit those citizens to debt for that purpose. But, as there is an obvious limit to the feasibleness of this in the course of time, and remembering always that the government itself is a spender and not an earner, the truism stands.

No one has been able to measure the dimensions of our post-war reemployment problem. There are too many imponderables. The degree to which technological labor saving improvements will affect the picture is at best a guess, as highly uncertain, for example, as is the number of women who will wish to continue working in factories after their men come home. These variables are so great that the present tendencies to reduce them to a mere mathematical formula may be more misleading than helpful. Broad factors, many of them psychological, will apply to this question and it is impossible to put a slide rule on them now. But, limiting the matter to the question of reemploying the men who are now in our armed forces, and looking at the dimensions of that problem, a few factors emerge:

Henry J. Taylor, whose penetrating interpretation of world events represents an outstanding contribution to war-time journalism, has been a constant commuter to Europe since 1923. From 1935 on he consistently warned of the military threat to us of Germany's totalitarianism

The year 1940 was America's record year for peacetime physical production. The U. S. Department of Commerce states that 46,000,000 peo-

ple were at work. Since then, such normal unemployment as existed has practically disappeared and the available manpower has been increased by 4,500,000 workers of school age, of over-age men, and by women.

In this and other ways, the number of people at work today has increased from 46,000,000 to 50,800,000 in spite of the fact that there are 10,000,000 more men in our armed forces now than there were in 1940.

Leaving a substantial standing army, navy and air corps for peacetime, 8,000,000 men should return from the armed forces. The problem centers on what they will do to earn their living for themselves and their families, and to contribute their share to the *maintenance* of the government, when they get back.

Nature of the Problem

The problem is neither as large nor as agonizing as it might appear. This is one way of saying that the difficulties are evident, but not insurmountable. The first encouraging feature is that many companies, large and small, are actively conscious that the problem will exist. Throughout our country, all types of businesses are preparing programs now for the conversion period. While none of these can contribute the answer to soldier reemployment, they are contributing a new approach which is a distinct advance over anything in our previous history. Some companies will overdo their expansion plans and, sadly enough, go broke. Others will underdo them and miss their market. But, right or wrong, industry is thinking in terms of work, and not in terms of idleness, after the war.

These companies are testing themselves along the following lines:

(1) What engineering, designing or development work must we do now on new products before they can be put into quick production?

(2) How should we project and gear up our advertising and merchandising to create profitable markets for us at maximum post-war production at lower prices? Are we prepared to attract our share of the pent-up demand for goods and services at the earliest possible moment?

(3) What types of personnel shall we need from the armed forces, and how shall we train them?

(4) Will additional working capital be required for our estimated post-war volume?

(5) What will the market be?

Treating all this in terms of reemployment, the rock-bottom fact is that, based on the most careful estimates which educational and other research foundations have supplied, the conclusion is remarkably unanimous: With bold preparation now, on a company-by-company basis, for plant expansion, new products, new designs, wider marketing, better training, *business can hire more persons now in peacetime work than in any previous peacetime period.*

Local and regional groups everywhere are enlisting members of the community to explain ways and means of reestablishing post-war reemployment on a company-by-company basis. Volunteer speakers are outlining carefully prepared plans to interested groups such as clubs, service organizations, trade associations, and so forth.

Take the city of Peoria, Illinois. On November 16th last year a group of Peoria business men named a steering committee for such activities. Within one month the chairman reported on the initial survey of the 1940 employment in Peoria, the present employment, and the first estimate on post-war employment made by Peoria employers. The results: 45 companies, large and small, employing over 97 percent of the employees in the community, estimated that they would employ over 30,000 workers at the end of the war against approximately 22,000 in the peak peacetime year of 1940. Whether they are right or wrong, this is the way American communities are thinking—and that is very important.

But, most important of all, this is also the way the men in our armed forces are thinking.

In the last war our army was trained to march and shoot. It was a dug-out army. It was drill-bound, mud-bound and hide-bound. But what conditioning are our men receiving today? In the special classifications alone, millions on millions of vital Americans, tough-minded, clear-eyed, and clear-headed, are zooming and banking in 400-mile-an-hour planes, bracing themselves against the spray of their PT boats, pressing the throttles of amphibious tanks, whirling on the miraculous carriages of anti-aircraft units, and jumping from the sky by the tens of thousands. They are diving in long-range submarines, scouting in mountains and valleys in fast moving columns, learning to live on the land. Thousands of Davids with "bazooka" guns are slaying Goliath tanks.

Americans Being Conditioned

Millions on millions of vital Americans are daily being conditioned in the spirit of enterprise.

Under the surface of the war, this is occurring on a scale so vast and with such an impelling effect that we here at home have no idea of the virtuous impact this will have when these men come home. In the last war we had a few Eddie Rickenbackers. In this war, in the sense of the free human spirit, which is the mainspring within any nation, we are making new Eddie Rickenbackers by the millions. And yet the existence of this overwhelming fact seems overlooked in the post-war discussions I have heard.

When the men I have seen overseas in this war return they are not going to be thinking in terms of selling apples on the corners. They are going to be thinking in terms of "let's step out and go places." *This is the great*

An Important Series of Articles on Industry's Post-war Problems

This article by Henry J. Taylor is the first of a series of twelve by outstanding political, social and industrial economists who have been selected by AERO DIGEST to give their views on post-war problems confronting American industry.

Noted economist, foreign correspondent, radio analyst on former Assistant Secretary of Commerce Edward Noble's Blue Network, and author of the sensational book *Men in Motion*, Taylor brings us a timely and searching analysis of one of the most poignant problems that will confront this nation and all other nations at the conclusion of the war.

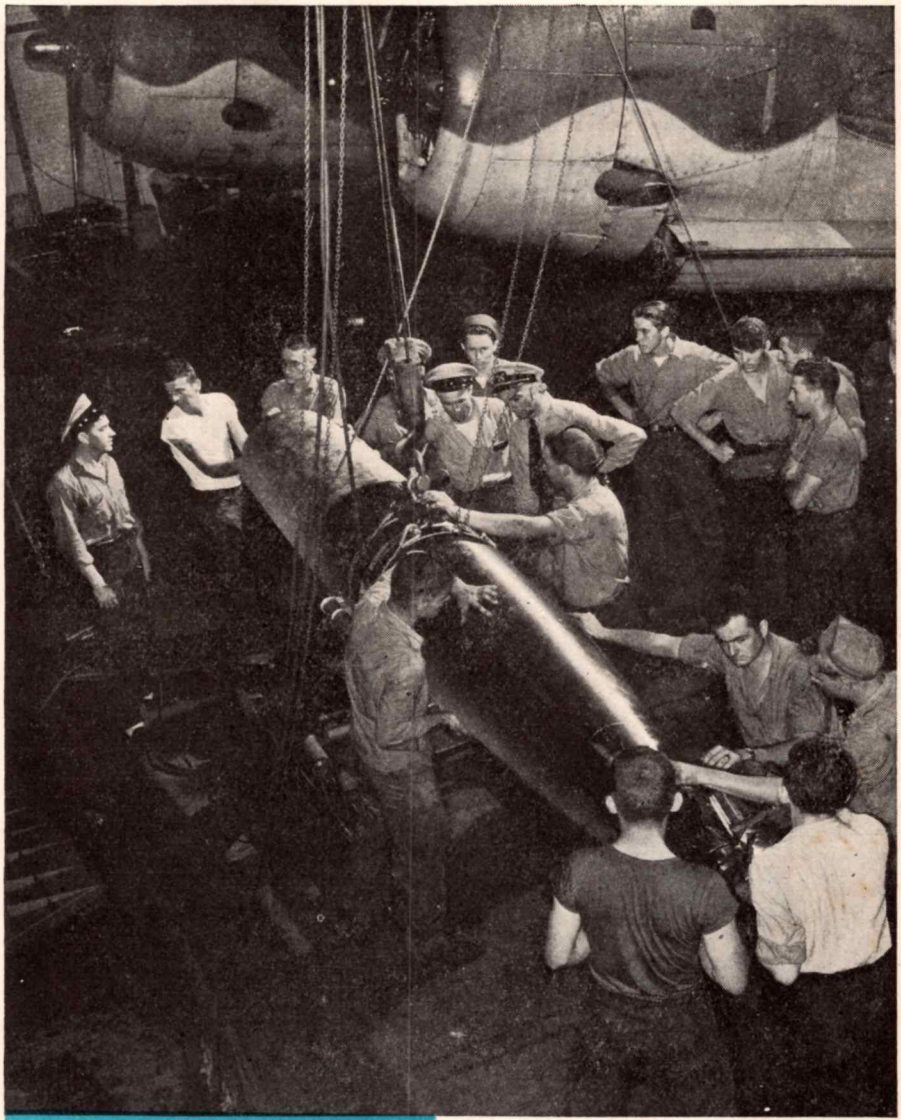
This new monthly feature of AERO DIGEST has been planned with a view to placing at the disposal of the industry the best obtainable talent, opinions and factual information for the benefit of those in each organization whose task it is to chart the course of their particular enterprise after the victory is won.

bulwark on which the attack on our reemployment problem can depend. Men are the essential element of the problem, and these men within themselves will contribute more to the solution of reemployment than any other single factor in the American scene.

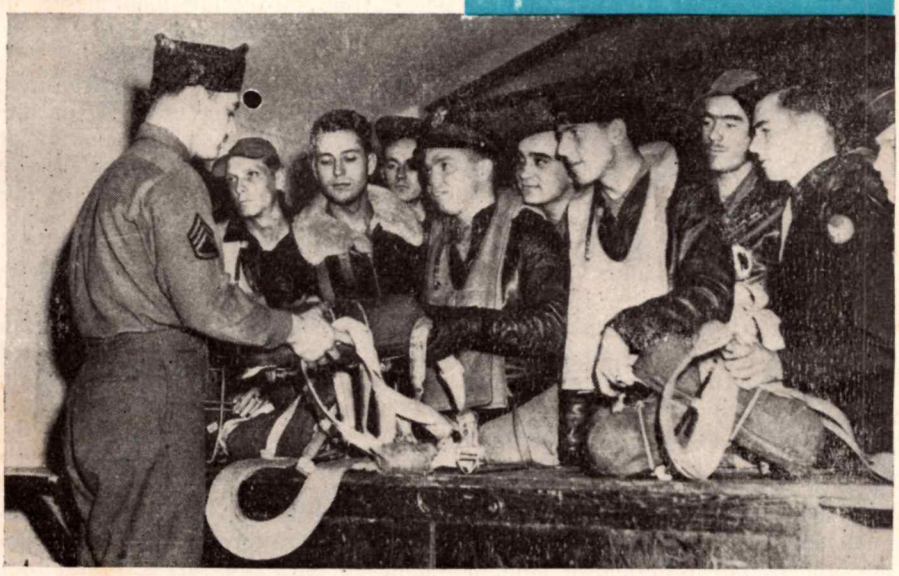
If the political climate in Washington is such as to discourage or discount their individual enterprise these men will see to it that such climate is changed, make no mistake about that. If this seems visionary, you have only to talk with our men overseas, as I have, to learn their impatience with any men and measure which show any prospect of retarding them in the future. It is impossible to over-emphasize this. These men are not going to bow in gratitude and ring the hand of Washingtonians who promise them some subsistence aid. All the deep-throated talk along these lines, which carries a distinctly defeatist tone as it drifts overseas, leaves these men cold indeed.

Not Thinking of Doles

It is significant to me that in all the discussions I have had with our men in the war areas, I have never once heard a single man suggest the hope for an adequate government dole. They simply are not thinking that way. And when they return they will not act that way. The men I have seen are not going to rake leaves—and will not appreciate any political ballyhoo which offers them only the opportunity to do so. If they go back to their old jobs they will do their old jobs better than ever before. Their sights have been lifted and they will be working for promotion. Countless others will swell the ranks of small business in an astounding way. I can't begin to tell you the number of ideas these men have for going into business for themselves. That some will succeed, and some will fail, is natural and elementary. But the point is that they are adventure-minded, enterprise-minded, sky-is-the-limit-minded. We simply are not aware of this fact at home.



Above: Aerial torpedo for a Navy TBF "Avenger," aboard a carrier in the South Pacific



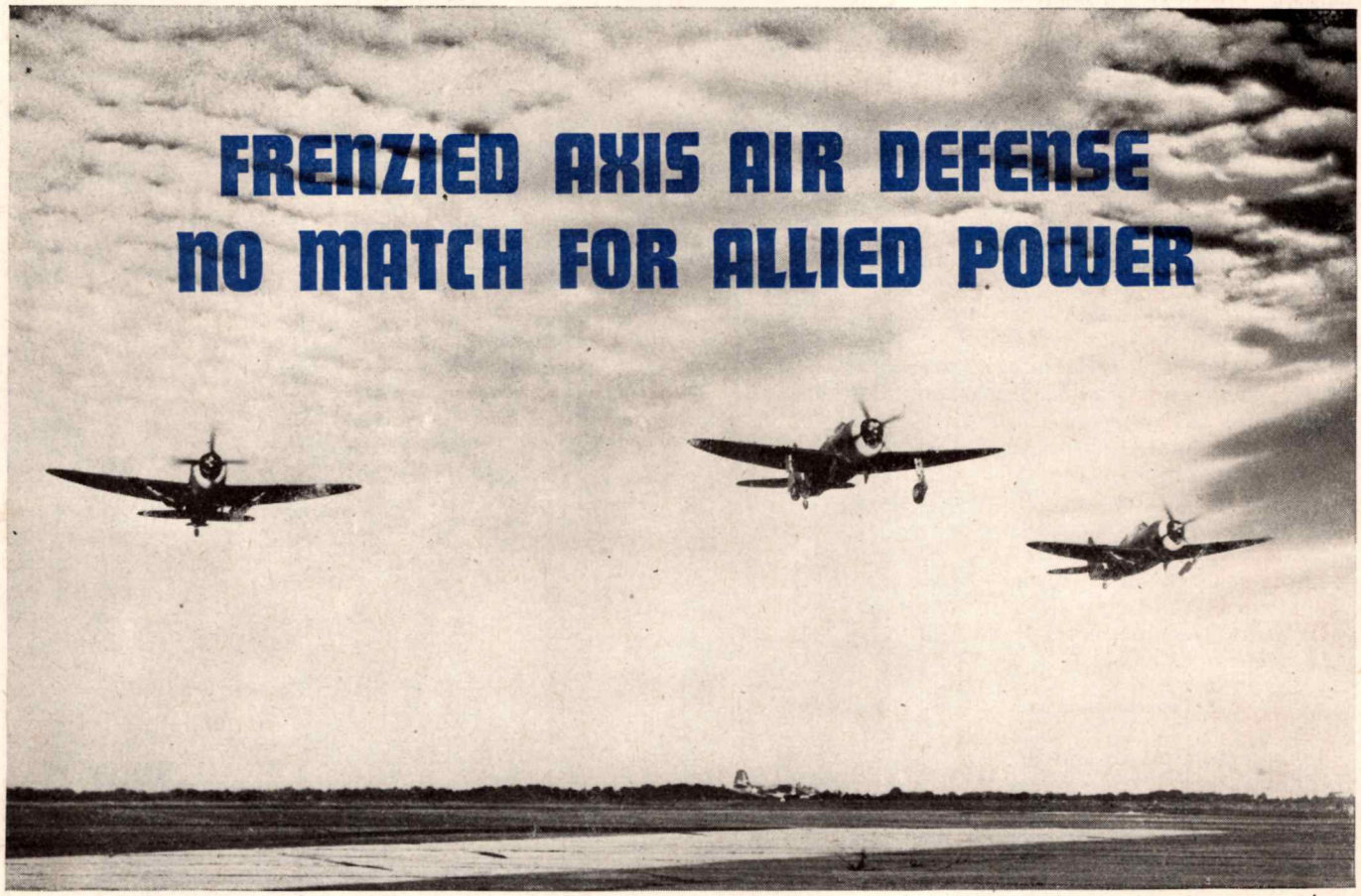
At a U.S. base somewhere in England, members of bomber crew check flying equipment on their return from a raid on "Fortress Europe"

Vast numbers of these men will make the best salesmen we have ever seen in this country. They will have the outlook for it, the temperament for it, and here is where their sky-is-the-limit attitude will be most important and useful to all.

It seems to me the current discussions about government vocational training, and even such plans within business groups, are top heavy with training for production. The value of vocational training for production is evident. But it is a case of cultivating the cultivated end of the garden while the weeds abound at the other end. The real bottleneck in vocational training will not be in production. It will be in selling. The disposal of our new production will be a bottleneck in our economy. Admittedly, our pro-

(*Continued on page* 280)

FRENZIED AXIS AIR DEFENSE NO MATCH FOR ALLIED POWER



Acme

Flying at 400 mph, at home at high altitudes and capable of diving at 700 mph these "Thunderbolts" head outward on a routine mission

Rising Crescendo in Allied Bombing of Germany . . . 30% of Nazi Industry Paralyzed with Only 5% Losses to Raiders . . . New Aircraft Fed to AAF and RAF Exceeds Corresponding German Supply 4 to 1 . . . AAF Wins Praise of RAF for Precision Bombing . . . Fighting and Bombing Tactics Changing from Day to Day . . . Aircraft Carrier Supersedes Battlewagon as Navy's Capital Ship . . . Superbombers in the Making

● With the second anniversary of Pearl Harbor close upon us, and fighting in every theatre of conflict steadily rising in crescendo, it is appropriate to pause to examine some of the features of aerial combat, newly accepted as modern warfare's dominant factor.

A glance first at the situation in Western Europe discloses that enemy planes knocked down in this area so far by the Allies total 10,000, while losses in the Mediterranean area are put at 5000. (Russia's claims are considerably higher.) Of these, the AAF accounted for 7312 up to Sept. 1, 1943, against a loss of 1867. Revealing the amazing pace at which this destruction is being stepped up, are the figures for the six months ending with Sept. 1, which show that our combat planes destroyed 5389 enemy aircraft and lost 1239. As a result of all this, the Ministry of Economic Warfare of Great Britain estimates that the combined operations of the AAF and the RAF have now ruined 30% of all German industry—almost half of this devastation being effected in the past half year.

Round-the-Clock Bombing

While battles are waged on many fronts, arguments erupt here and there in support or condemnation of the overall strategy employed. The AAF and the RAF in Great Britain are convinced that they could have destroyed the entire Luftwaffe before the end of 1943, if left alone. Instead they complain that their European flights were emasculated time and again by the diversion to other fronts, of fighters for air cover, and bombers to decimate the enemy in these sectors. On the other hand, a full-blown land invasion of Germany is developing in Italy, our forces are mopping-up in the Pacific and Russia is steadily gaining.

The RAF and the AAF continue round-the-clock bombing of Europe from Great Britain—area-bombing at night by the former, and high-altitude precision bombing by day by the latter. Area-bombing is saturation bombing of an entire area, while precision bombing is the bombing of special targets within an area.

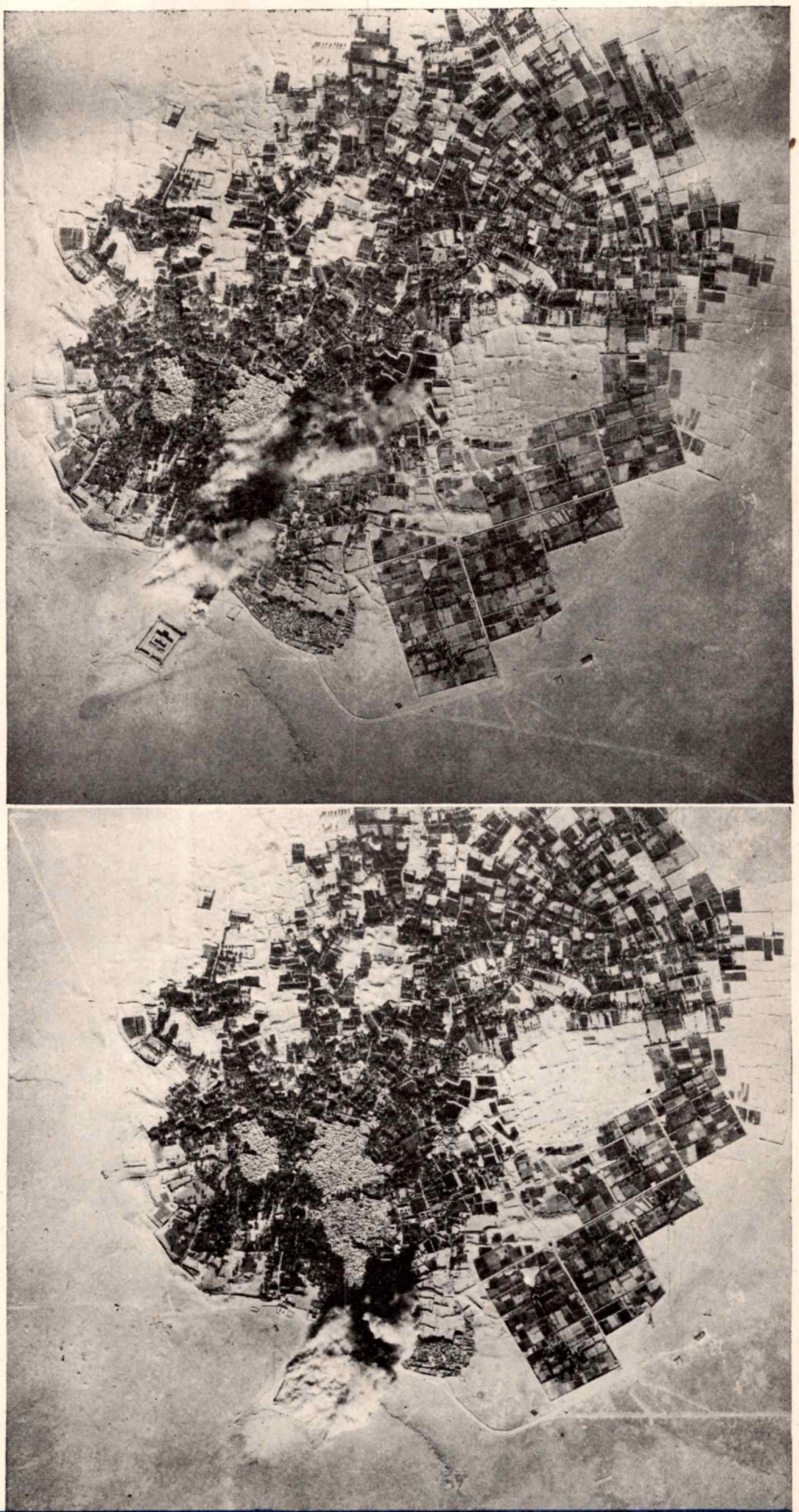
Large-scale daylight raids from high altitudes naturally require unlimited ceilings, and such days come seldom over Europe, especially in the winter. Because of this and because of the strength of the German fighter force and anti-aircraft gun defenses, and with the help of our increasing output, bomber forces were gradually built up until, by July 1, 1943, they

exceeded 1000 heavy bombers, based on England. These large-scale attacks forced the Germans to increase their production of fighter airplanes at the expense of bomber output, putting them definitely on the defensive. It also caused them to send new production largely to their western front, to withdraw experienced single-engine fighter pilots from the Mediterranean front to the defense of Germany, and later to withdraw fighter aircraft from Russia. The net result was that the Germans were unable to conduct any sustained offensives last summer in Russia or build up sufficient strength in the central Mediterranean to oppose the Allied offensive.

In the "Soup" Raids

Meanwhile a new technique has been introduced. Design ingenuity at home and flight crew versatility in action, have combined to put what is called "interchangeability" into our four-engined bombers. Now flights concealed in the clouds on overcast days, are being made at low levels. For the same distance, less gasoline is required, and more bombs can be carried for which extra racks have been installed on the *Fortresses*. These in the "soup" raids have been so successful that Air Chief Marshal Sir Arthur T. Harris of the Bomber Command, RAF, has promised to blast German war centers through snow, rain or hail, as well as in clear weather.

With the occupation of Southern Italy, at half the distance to Germany and with better weather conditions, some thought that Great Britain might possibly become a secondary base in this phase of the war. U. S. bombers escorted by long-range fighters based on Italy, had already struck at Austria (Oct. 24), the one Nazi area heretofore almost immune from air attack. This was announced from General Eisenhower's headquarters in Africa. According to the Berlin radio, the attackers flew in from Italian bases and continued on to Great Britain, which would bring the raid into the category of shuttle-bombing. The Nazi further stated that 300 heavy bombers and 200 fighters participated, and that Hungary was also bombed. AAF headquarters, however, were mum. It



U. S. Army Air Forces

Remarkable aerial photographs of effect of precision bombing of selected target by Allied aircraft during attack on Fort Gadames in Libya. Structures damaged in first raid (top) and destroyed and left burning in second attack (bottom) highlight pin-point accuracy possible with American Norden bombsight. Two separate bombings hit almost same spot

was reported that this was the beginning of the Allied promise to throw the Mediterranean aerial fleet into a shuttle-bombing campaign against Germany, in cooperation with the aerial armada based on England. Analysis of the situation, however, shows that Southern Italian bases are actually farther away from the strategic German industrial centers which are, for the most part, within a 600-mile radius of British airfields. As for weather, it is just as thick over a target whether an attack is made from the south or the west.

Fortress Europe Badly Hurt

The desperate efforts to combat the systematic bombing of industrial centers in Germany is eloquent testimony that Fortress Europe is being badly hurt. Germany is said to have massed 60% of her operating force, estimated at 4500 aircraft, and 80% of her anti-aircraft guns, for the single purpose of thwarting this piecemeal devastation. It is reported that 1800 fighters are concentrated in Denmark and Belgium for interception. New tactics, new strategy are frantically being developed and tried out by the Nazis with much hope and some success.

The culmination of this was the shooting down of 60 American four-engined bombers ($20,000,000 worth of equipment) or 15% of the attacking force including 593 U. S. airmen, during the raid on the Schweinfurt ball-bearing works on Oct. 14. This was the greatest loss in the history of the Eighth Air Force, but in return at least half the ball-bearing capacity of Germany was rendered inactive, and 103 Nazi fighter aircraft shot down. Germany's mechanized war machine and her air force would eventually become helpless without bearings, and the possibility that even a quarter of this production can be restored is remote.

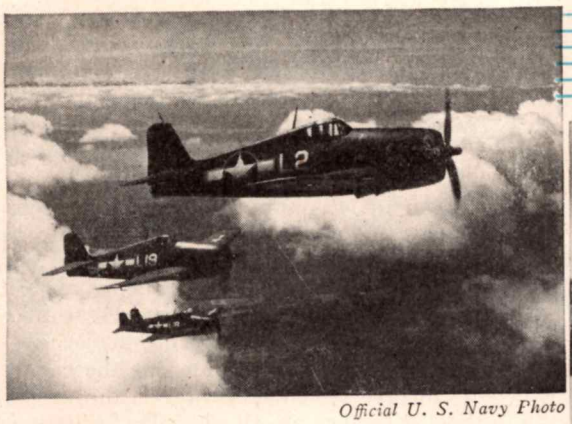
While our bomber losses rose to the high rate of 174 for the first 23 days of October, this is not prohibitive, and is well worth the toll we are exacting from the enemy. All told, AAF and RAF losses average out at less than 5%. German losses on the other hand, are said to have outrun production. One London observer, balancing current German losses against German fighter planes on hand and estimated current production, thought the Nazis would be bereft of fighter planes by Christmas, 1943. In the latter part of 1942, the Nazis may have had 20,000 fighters and as it is necessary to figure on six aircraft on the ground for every one in the air, it is clear that this reserve was meager. Estimates of German fighter output run from 900 to 2000 a month. On the other hand, the British and American Air Forces are fed by an ever-broadening supply of new aircraft which together exceeds the corresponding German supply, by more than four to one, according to a recent statement by Winston Churchill.

Long Range Rockets

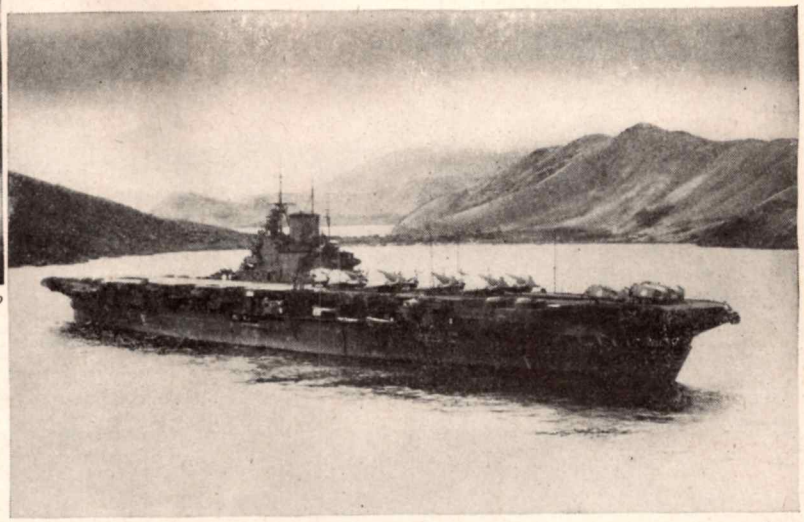
The use of rockets launched from rocket-guns mounted in German fighters was reported by pilots returning from the Schweinfurt raid. Twin-engined fighters were said to mount four rocket-guns or launchers each, and the rockets themselves to have an effective range of 2000 yds with an explosive effect twice that of the largest flak. This range is said to be well beyond that of our bomber's heavy

Smoke rises from the ruined Focke-Wulf Aircraft plant as "Flying Fortresses" of the 8th Air Force Bomber Command wheel for home after the raid. German defenses were caught napping when our bombers visited the giant plant and virtually destroyed it

Acme



Official U. S. Navy Photo



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Above: Grumman "Hellcat", Navy's newest fighter aircraft, got its baptism of fire in October. 51 Jap planes destroyed in two raids with the loss of only two, a 51 to 2 ratio in favor of the "Hellcats". Right: British Aircraft carrier Victorious in S. Pacific, loaded with U. S. Navy and torpedo planes

machine guns. Something new in formations was reported, the Germans attacking in layers of 60 planes each. The enemy is also said to be using a winged glider propelled by a rocket and carrying a bomb. This missile is thought to be radio-controlled and dropped from airplanes onto bomber formations. Maybe these are the much-touted secret weapons stories about which the Nazis have been broadcasting, and quite probably they are pick-ups from items developed and discarded long ago.

The magnificent armament of the *Flying Fortress* has always made it more than a match for the German fighters that got within 1000 yds of its .50 cal. machine guns. To this a so-called "chin turret" has been added. This is a power-driven turret just under the nose, in which are now located, with remote control, the separate hand-operated front guns of the bomber. This gives the gunner two guns in the place of one, or twice the fire power against a head-on assailant. This set-up is similar to the power turret and guns recently built into the *Liberator*.

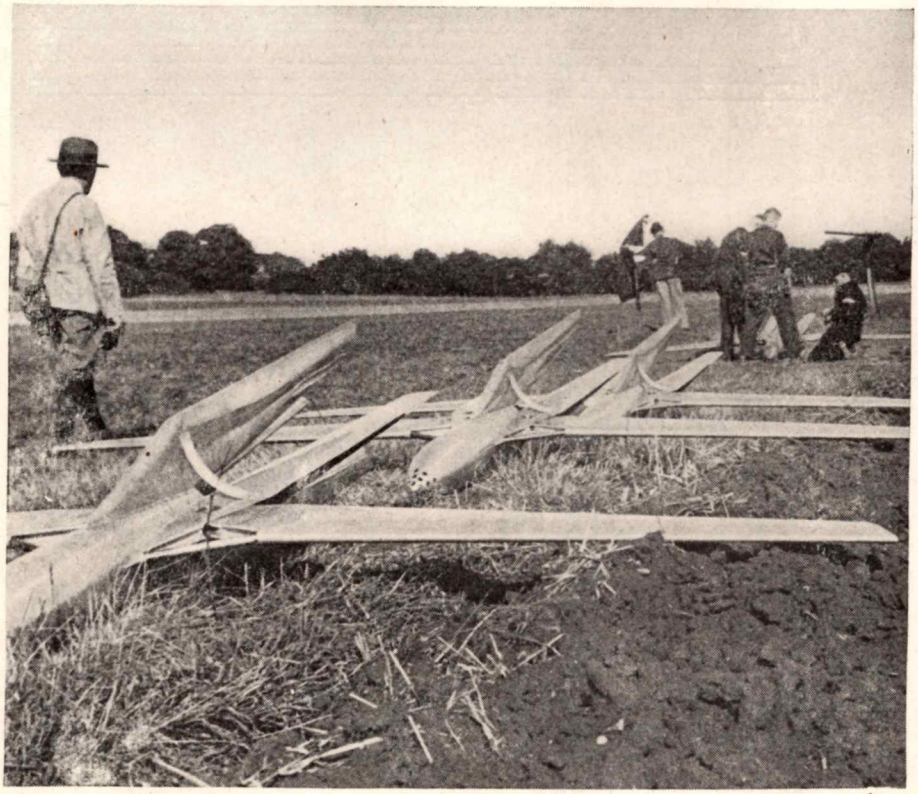
AAF and RAF Fight Together

British criticism of AAF high altitude precision bombing in daylight as contrasted with their own area bombing night raids, was long and loud at the beginning. The record of results has forced them to change their tune and now only praise is heard from them. One of the loudest critics, Peter Masefield, aviation editor of the London "Sunday Times" and technical editor of "The Aeroplane," also a London publication, talks very differently now. Recently he said, "At one time we in England did not realize the potentialities of the American precision-pattern bombing by day, just as many people in America had not realized what could be achieved by night area-bombing as practiced by the RAF. Now that we have had experience with each, in combination side-by-side, we realize that the two dovetail as though originally designed to go together and that each is far more effective in its total achievements because of the other. The one requisite is a large and continuous scale of attack, allowing no respite to the enemy. That is planned and that is now in progress."

How precise is pin-point bombing from heights of 20,000 to 25,000 ft? At the beginning of 1943, about 5½% of the bombs dropped fell within a 2000-ft circle with the target as the center. Today, the average is 24.8% and a high of 35.8% was recorded as the best month. But a shift in bombing technique has been made recently, a shift made possible by the growing size of our flights and the tight formations used for protection. Mass-formation pattern bombing led by one bombardier, has been added to precision bombing. Flights of three, six and eighteen aircraft will be led by a single bombardier who acts as pilot, navigator and bombardier for the entire flight. He flies his plane over the target followed by the others who release their bombs the instant they see his drop from the bomb bay. One or two other bombardiers in the flight

BOX SCORES OF AMERICAN COMBAT AIRCRAFT

Name & Location of Air Force	When	Enemy Loss	Our Loss	Rate
Army Air Forces	Dec. 7, 1941-Sept. 1, 1943	7312 enemy planes	1867 planes	Almost 4 to 1
Army Air Forces	March 1-Sept. 1, 1943	5389 enemy planes	1239 planes	Better than 4 to 1
Heavy Bombers	Jan. 1-June 30, 1943	1333 enemy planes	316 planes	Better than 4 to 1
Medium Bombers	Jan. 1-June 30, 1943	113 enemy planes	69 planes	Almost 2 to 1
Fighters	Jan. 1-June 30, 1943	763 enemy planes	375 planes	Better than 2 to 1
Fortresses of 8th American Air Force based in Britain	Month of July, 1943 while dropping 3,600 tons of bombs on enemy targets	500 German fighters	108 Fortresses	Better than 4 to 1
Eighth and Ninth American Air Forces, over Sicily, Sardinia and Southern Italy	Month of July, 1943 while dropping 12,460 tons of bombs	342 enemy planes	190 planes	Almost 2 to 1
Fourteenth American Air Force—China	13 Months from July 4, 1942 to August, 4, 1943	442 enemy planes	51 planes	Almost 9 to 1
Navy—North Solomons	First 10 days of last June's offensive	199 enemy planes	34 planes	Better than 5 to 1



Acme

Glider with bomb, propelled by rocket and possibly radio-controlled, revived by Germans. If this is their much boasted secret weapon—the Nazis are slipping

check his accuracy and can interfere if they find him off the target.

Pulverizing particularly important Nazi targets with the precision of rifle fire is being accomplished by AAF bombers after full dress rehearsals on scale models. The Ploesti and neighboring oil refineries mission in Rumania is an example. Bomber crews examined hundreds of photographs, saw motion pictures, attended lectures by a former manager of one of the Ploesti plants, and finally practice-bombed a scale replica laid out on the ground. The raid was made from bases in North Africa by 177 B-24s which were prepared for a 2400-mile low altitude run, by installing an extra releasable fuel tank in the bomb bay. Extra .50 cal. machine guns were mounted in the noses of the lead planes so that they could strafe the entire area.

Ploesti Raid at Low Altitude

The raid was made with five groups of bombers, one group at least numbering 48 flying in sections of five. The first planes carried 1000-lb bombs with 60 min delay action fuses, lest the last members of the flight be damaged by the resulting blast or fire. While the mission was accomplished in 75 sec in rehearsal, allowances had to be made for planes delayed en route. The rear members of the flight carried 500-lb bombs with 45 sec delay fuses.

The flight crossed the Mediterranean at 2000 ft, in close formation (25 ft between wing tips), rose to 10,000 ft to get over the mountains, and then dropped to 2500 ft and followed the Danube River to the target when it dropped to 20 ft and less, dusting the tops of trees and corn stalks in some instances. In addition to dead accuracy in bombing, the low altitude also permitted close-in strafing, it limited the accuracy of the anti-aircraft guns, and it prevented the enemy fighters from diving onto the visiting bombers.

Flak guns 20-mm and 40-mm with plenty of machine guns, opened up about two miles from the target and the raiders started strafing oil tanks when within range. These exploded with terrific violence, throwing flames 500 ft in the air and frequently into the open bomb bays of the raiders. This would probably have thrown them off their target had they not rehearsed in advance. Enemy planes, ME-109s and 110s, jumped them after the bombs were dropped, but the raiders were flying too low for the enemy to dive on them. However, the enemy did lazy eights all over the formation. The result of this mission was that a large part of the entire field, including refinery installations, power houses, storage, etc., was wiped out entirely.

Germans Now Using Flares

New tactics to hinder the bombing of Germany by the Allies include recent night illumination of the aerial battlefield with flares. Formerly flares had been used by bombers to light up the target and to dazzle searchlight crews, etc. Now that night fighters have taken precedence over anti-aircraft gunfire from the ground as the principal form of defense, flares are being employed to light up the bombers for the counter-attack. The first time was last August, when British bombers raided Berlin. German airplanes flew above and dropped special flares attached to parachutes to disclose the attacking bombers to the defensive fighters. Of course, this lighted up the German attackers as well, and a number were immediately shot down. While the Germans did not succeed in thwarting the Berlin raid, the advantage of illuminated night aerial fighting was probably with the enemy, for night bombers like darkness. On the other hand, air defense has not mastered air attack by night.

Proof positive of the indispensable

From Tokyo to Tobruk and from Russia to New Guinea, these 14-ton "Mitchell" bombers (B-25) are continuously sewing devastation

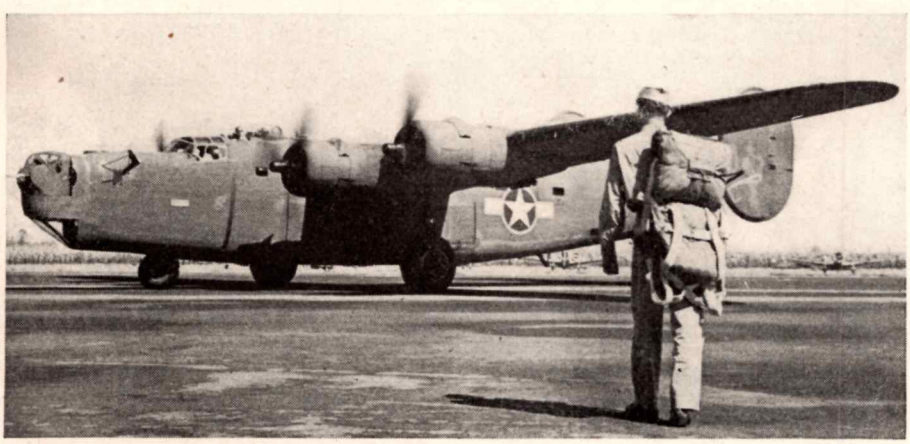
Radio and pilot compartment of a Martin PBM "Mariner," twin-engined Navy patrol bomber

Official U. S. Navy Photo

value of air control over a battlefield was driven home to Army and Navy commanders during the advance in North Africa, the landing at Salerno and subsequent fighting in Italy. The occupation of Salerno was called "the most daring amphibious operation we have yet launched or which has ever been launched on similar scale", by Prime Minister Winston Churchill. The hazardous element was that the landing on the beaches was made at the extreme limit of the AAF umbrella of land-based combat planes. Churchill summed this up as follows: "From the Gulf of Salerno we were at the extreme range of shore-based aircraft flying from Palermo and other conquered Sicilian fields. Until we gained refuelling stations and landing spaces, our single-engine fighter squadrons had but a quarter hour's activity over the battlefield area.

It seems probable that carrier-based aircraft were employed to cover the invading armada and landing, and that the land-based fighter planes were used as a protective umbrella over the carriers. Furthermore, these carriers may have been "floating bases" provided at some point between Sicily and Salerno.

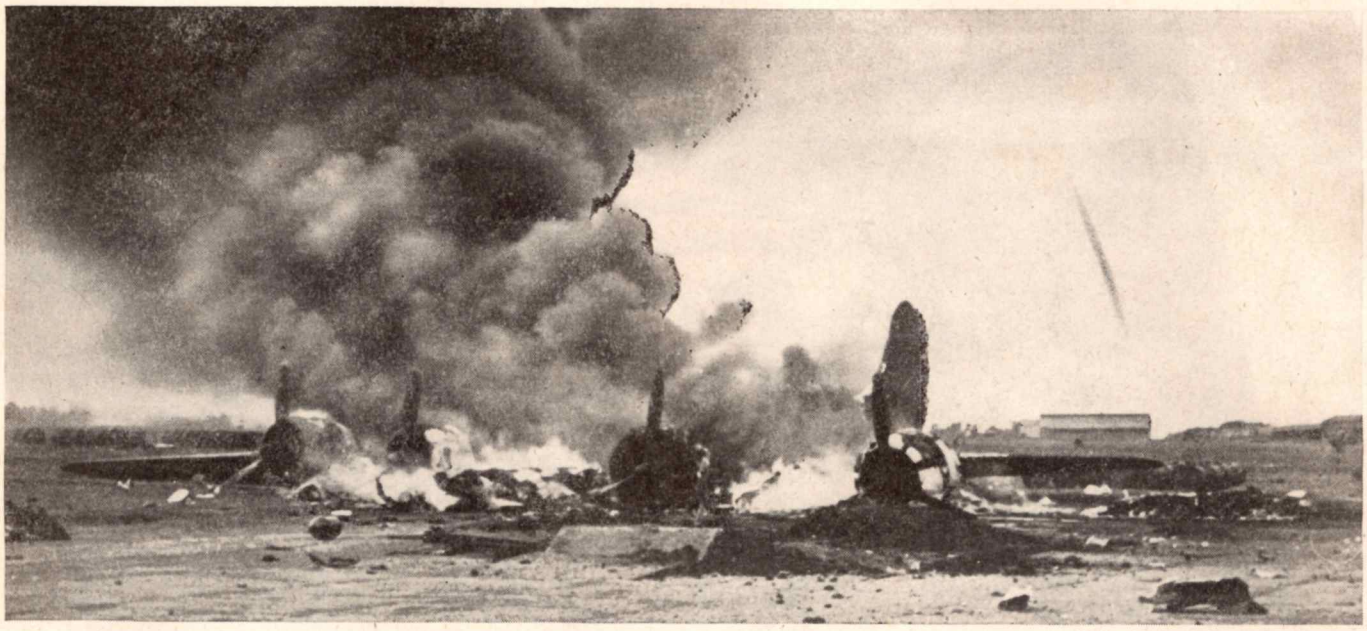
Consolidated's B-24 "Liberator" bomber powered with four 1200 hp Pratt & Whitney motors, has a range of 3000 miles and speed of 300 mph. Carries fourteen .50 cal. machine guns and a crew of from 5 to 10



Fighter Planes at Salerno

Without cover for the carriers, it would have required all the carrier-based planes to protect their own bases. The land-based fighters, therefore, released the carrier-based aircraft for the important invasion umbrella. While the Navy also supported the landing of troops and equipment at Salerno, it would have been helpless without the protection of fighter aircraft. We, therefore, have the picture of carrier protection by land-based fighters from Sicily, and battleship protection by carrier-based planes, so that the Navy could help support landing operations. This improvisation might be looked upon as the direct result of the failure in the earlier military concept to

(*Continued on page* 313)



Netherlands Information Bureau

Stricken "Fortress" at airport near Bandoeng, Java, February 17th, 1942, following surpraise raid by Japanese

THE DUTCH ARE COMING BACK—FLYING

● Holland fell in the spring of 1940, then two years later her East Indies empire was swept away in the whirlwind of aggression. The green fields of the Netherlands during its desperate five-day resistance were incarnadined by the blood of one quarter of the Dutch army. A like debacle marked the Japanese invasion of Java and Sumatra in March of 1942. But the war has not been lost and the people of Queen Wilhelmina are doing their part toward victory; furthermore they are planning their post-war future.

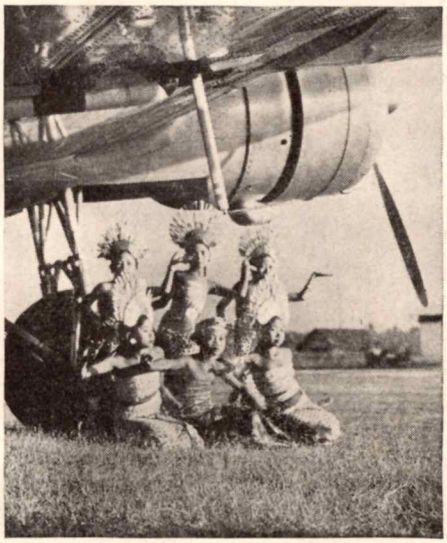
Present Activities and Future Plans

The Dutch are coming back! And if reports of their current activities and long-range plans are any criterion, they are coming back—*flying*. Operating out of the British Isles and in the Mediterranean area as members of the Royal Dutch Naval Air Service and—as individuals—under the standard of the RAF, Dutch flyers have been rendering a brilliant account of themselves ever since May, 1940. Using a number of different types of British and American planes, *Halifax* and *Mitchell* bombers in particular, their exploits against enemy submarines and military targets along the French coast are most noteworthy.

From the South Pacific theater, where the initial overwhelming successes of the Japs are beginning only now to be counterpoised, come tidings of an even greater opportunity for Dutch airmen to settle accounts with the Axis. And how well they are taking advantage of this, is becoming daily more evident. Operating from a remote base in the vast northern fringe of Australia, one of the most unique of Allied air squadrons—flying the red, white, and blue of the Netherlands—is emerging as a valuable auxiliary of the hard-hitting air forces with which General Douglas MacArthur is hammering the Japs.

Group of Balinese dancers assume picturesque pose under KLM air liner at one of Dutch East Indies airports, before "Pearl Harbor"

Royal Dutch Airlines

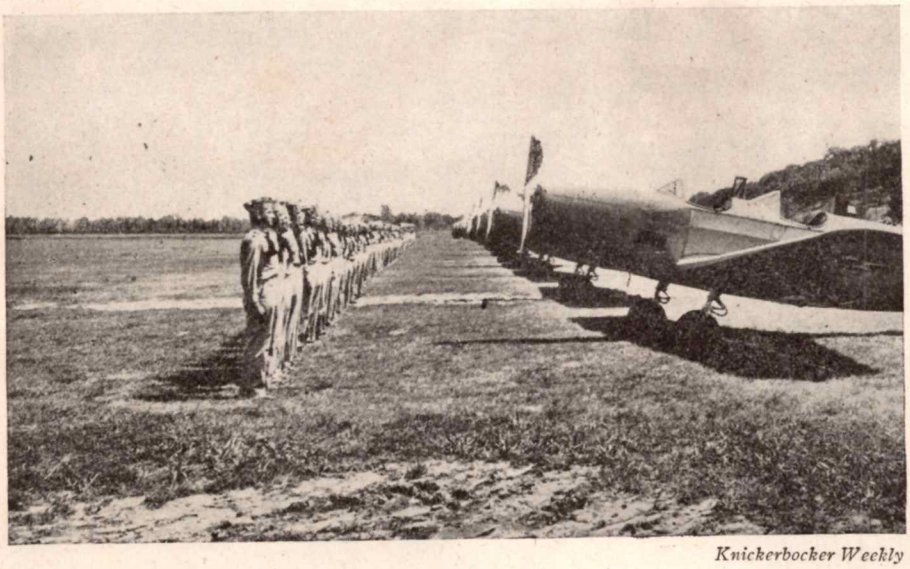


This unit, a majority of its members hailing from the Dutch East Indies, has a particular grudge to settle with the Nipponese. It is called the "Incognito Squadron," a nickname which stems from the fact that the identity of its personnel cannot be divulged for fear of reprisals by the invader against their relatives who are still in the Indies. The force operates under the command of Lieut. Col. B. J. Fiedeldij, a Hollander, aided by an Australian, a squadron leader of the RAAF.

Soon after the fall of the Indies, last year, the Dutch commander was commissioned by his government to form the unit, and the Australian officer joined him some months ago to take care of the Australian personnel. Col. Fiedeldij is an air veteran.

Men Proud of American Planes

The airplanes flown are mainly *Mitchells* — speedy "truckhorses" of which the men are immensely proud. Already the squadron has flown more than 300,000 miles in bombing and strafing missions against the Japanese, in the Indies and nearby points. Up to the end of October, these flyers had carried out 100 separate missions with the loss of but a few planes. They had destroyed or damaged at least eighteen *Zeros* and inflicted major damage to



Knickerbocker Weekly

Left: Students of the Royal Netherlands Military Flying School lined up before their Fairchild trainers at Fort Leavenworth airfield. Below: Queen Wilhelmina arriving at Pittsfield, Mass. airport for ceremonies at which members of Royal Netherlands Airforce received decorations

Netherlands Information Bureau

Jap bases and shipping. These men have pounded bases in Timor, Dutch New Guinea, and in the Kai Islands.

Originally recruited in the main from among the remnants of the Dutch East Indies air forces, this squadron of nameless men is now receiving welcome reinforcement from the Royal Netherlands Military Flying School at Jackson, Miss. Even before Java fell plans were laid to continue flight training in Australia, but facilities there were not adequate for training a large number of men. Hence it was, that in the spring of 1942 the RNMFS was established in the United States for the purpose of making available a training station for Netherlands flyers.

When these men came to Jackson fresh from the Far Eastern battlegrounds—bedraggled, wounded, many of them fantastically arrayed—they were given a rousing welcome.

Many of these youngsters had been through the invasion of Holland and fought the Germans on land and water as well as in the air.

Subsequently, some of them had made their way to liberty and the Netherlands East Indies. Others had been imprisoned by the Nazi conquerors, escaped through a war-torn Europe to Africa or South America, and thence made their way out to join the rapidly growing defense forces on the island of Java.

They Fought the "Zeros"

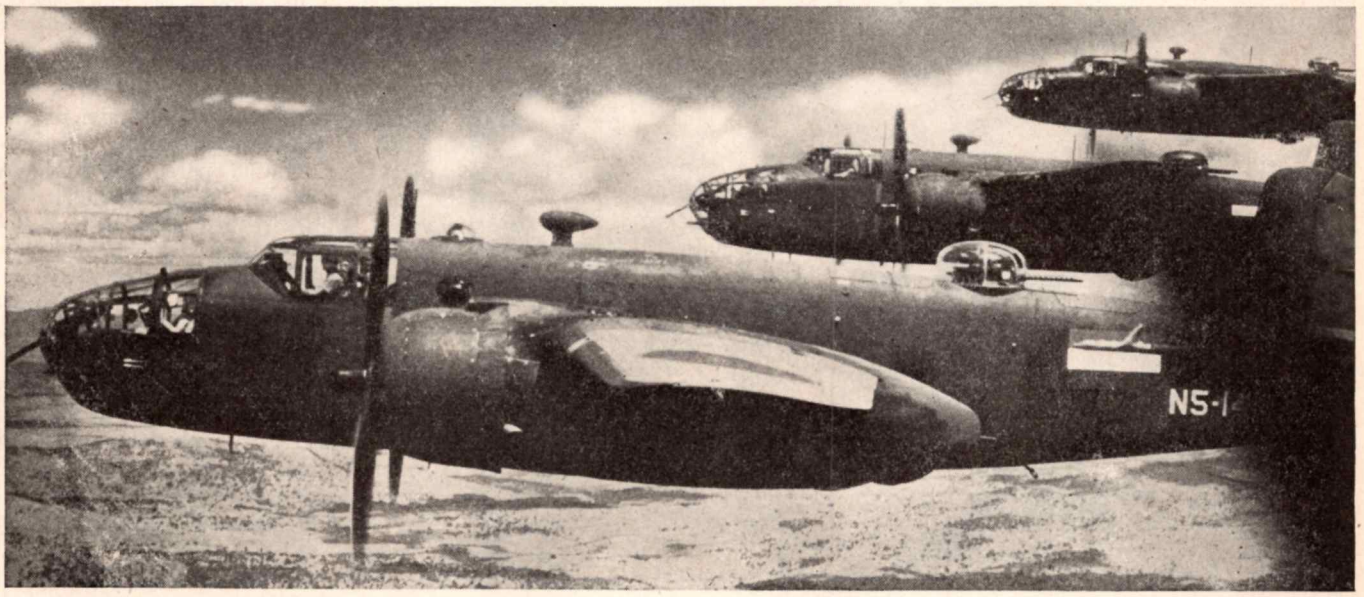
The majority of them were stationed in the Indies at the time of Pearl Harbor. They were the men who flew to Singapore and the Malayan jungles to help their embattled Allies. They fought the numerically superior squadrons of *Zeros* over the oil refineries of Balikpapan and the Borneo wilderness.

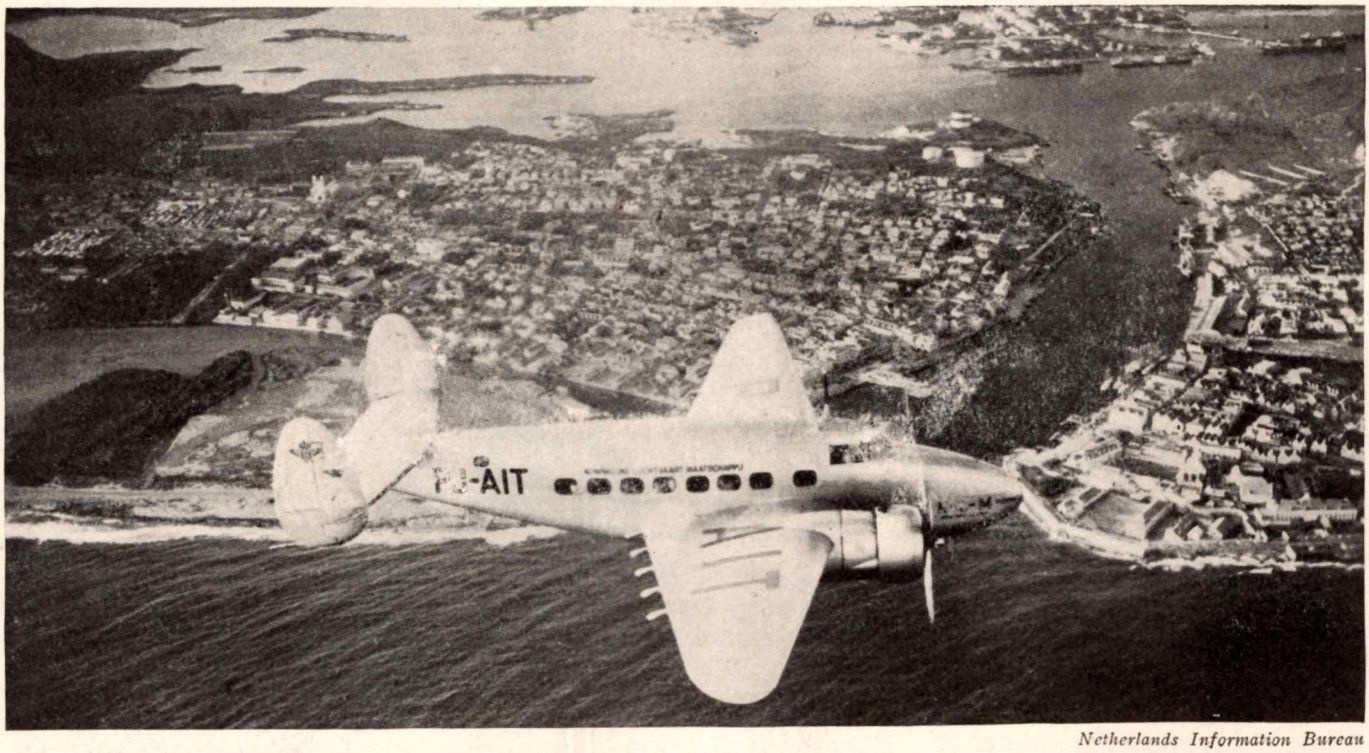
A training school for flyers has seldom had a more battle-hardened corps of instructors than the RNMFS. Guided by Major-General L. H. van Oyen, commander of the Netherlands East Indies Army Air Forces, they soon contrived to build up a splendidly functioning outfit. For a while a unit for primary instruction was settled at Fort Leavenworth, Kansas, under Colonel Max van Haselen. But as soon as these students were somewhat advanced they, too, were transferred to Jackson.

The school had at its disposal a number of Vultee trainers and Beechcraft and Lockheed twin-engined bombers. Soon these aircraft could be seen in an ever-widening circle around the home

Squadron of "Mitchell" bombers of Royal Netherlands Airforce in formation somewhere over Australia during a mission

Netherlands Information Bureau





Netherlands Information Bureau

Air view of Willemstad, Curaçao's capital, from the ocean side. In the foreground is one of the KLM airliners

base. So intense was the training course that only ten months after the arrival of the men in the United States, the first mass test flights were made.

In February, 1943, the first large group of Dutch and Indonesian airmen received their wings, and in quick succession more test flights followed. Up and down the American continent they went, through Canada and to the Netherlands West Indies—braving all the hazards of wind and weather and difficult terrain. As part of a "final examination," a group of eight bombers successfully carried out all the maneuvers of a full-fledged air raid over the city of Lincoln, Nebraska.

Last spring witnessed the departure for Australia of the first group of graduates. By the middle of summer the Jackson flying school had almost completed its task. At present only special classes are continued for a few of those who started late. Already Gen. van Oyen has arrived in Australia to take command of the air forces that were formed under his leadership.

Seven hundred Netherlands air soldiers have been trained in this school. They form a significant section of the Allied bomber force which now pours daily doses of destruction upon the Japs in New Guinea and the East Indies

Most of them are highly-skilled flyers who, even in the short time of their renewed activity against the enemy, have scored outstanding successes. During July and August, for example, of 91 bombing missions carried out over the East Indies archipelago from Australian bases, 15 were accomplished by Dutch boys alone. Thirty times the boys from Jackson, have thus far raided the island of Timor; 17 times they have appeared above the Tanimbar Islands, and they have bombed New Guinea equally often. At every new visit their attacking force increases.

Young Javanese school children eager to be initiated into mysteries of aviation, inspect a KLM airliner at Soerabaya

Netherlands Information Bureau

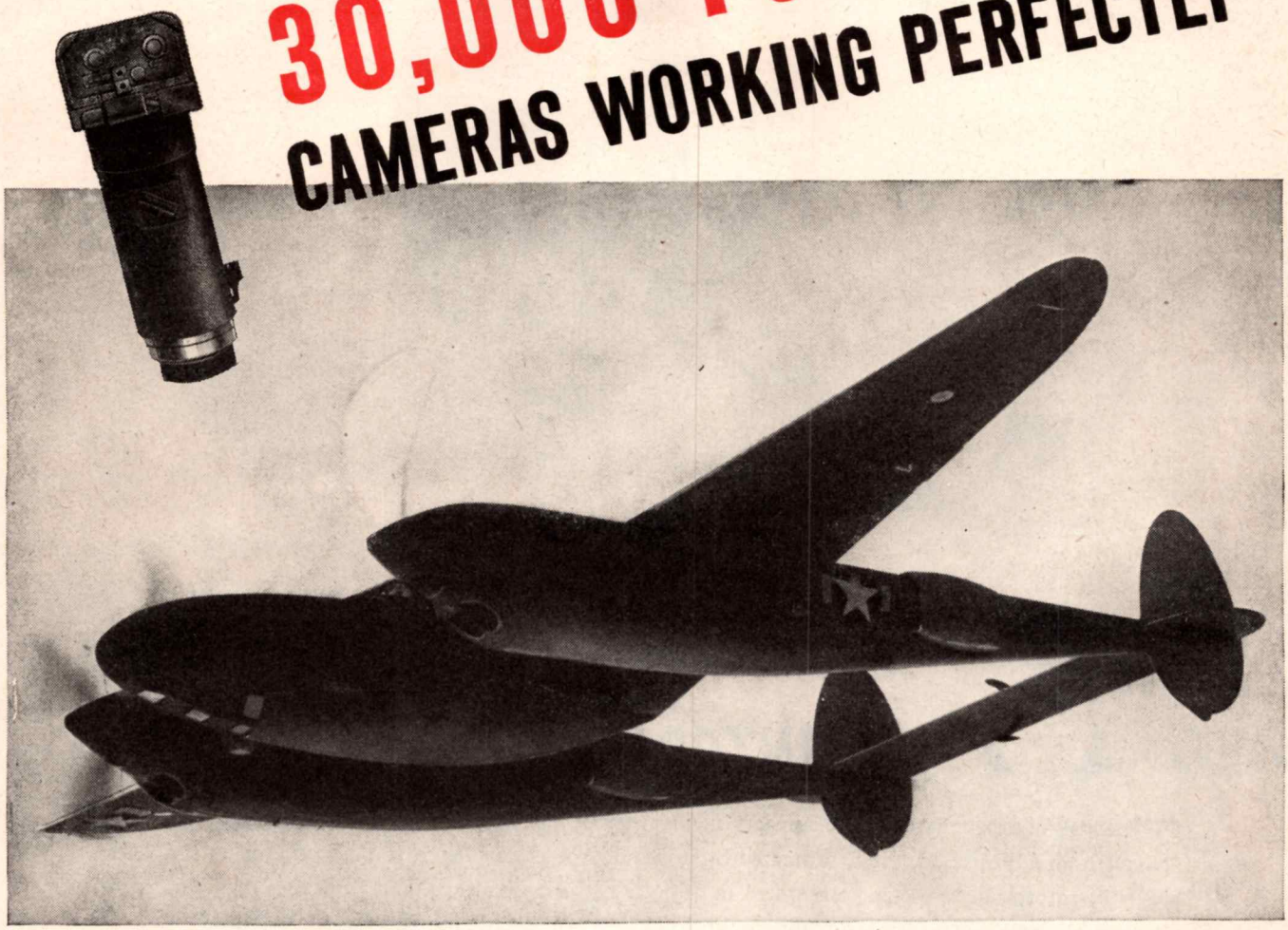
The Royal Dutch Airlines

Nor do the contributions of its *fighting* pilots, navigators, bombardiers and ground personnel compass the achievements of the Netherlands' aerial fellowship in helping to win the war. A goodly share of consideration is due the Royal Dutch Airlines (KLM), an organization operating international routes ever since 1919.

A regular Amsterdam-Batavia service was established in 1927, at which time KLM was flying Fokker machines. Shortly thereafter, with the adoption of American-built Douglas transports, the trip was standardized at five-and-a-half days and the frequency of the service increased to twice weekly.

(*Continued on page* 287)

30,000 Feet
CAMERAS WORKING PERFECTLY



FLIGHT records show that planes flying at 30,000 ft. and above experience temperatures as low as —100°F. In this extreme cold, cameras and control mechanisms may *freeze up, fail to function.*

To correct this high-altitude flying hazard, we offer *Texaco* **LOW-TEMP** *Grease.*

Texaco **LOW-TEMP** *Grease,* the result of a 2 years' research, has had an enthusiastic reception because it assures effective lubrication throughout a temperature range from 100°F. below to 175° above zero.

A Texaco Aviation Engineer is at your service in helping to solve low temperature problems. Address —

The Texas Company, *Aviation Division,* 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

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★ More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

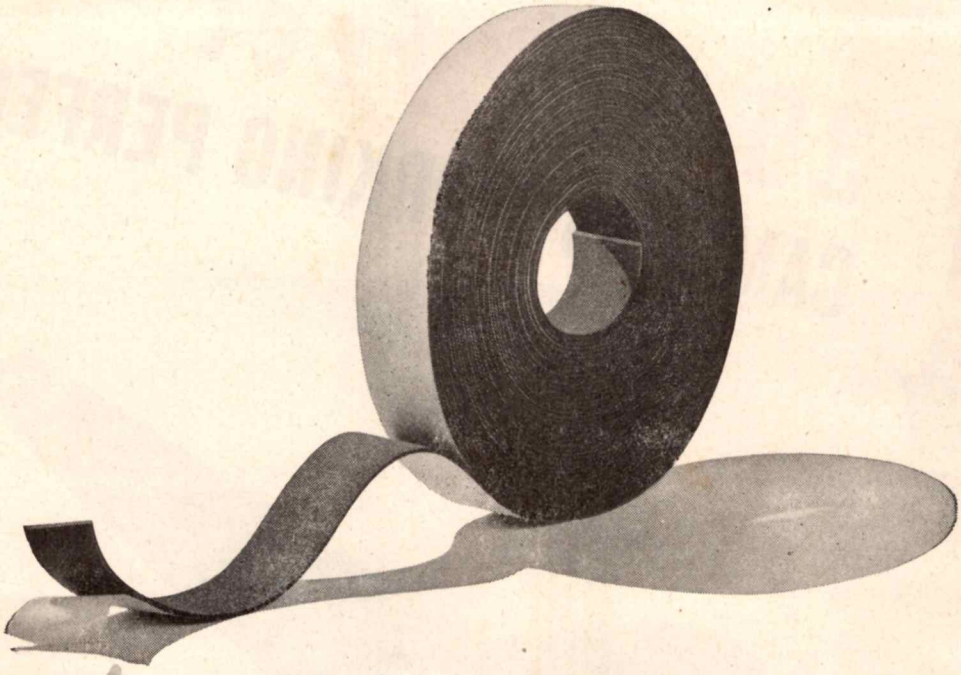
★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

TEXACO

TEXACO LOW-TEMP GREASE

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT — CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY



The Glazing Tape

THAT OUTGREW ITS NAME

THE roll of tape you see above consists of an Armstrong's Cork-and-Sponged-Rubber Composition with an adhesive backing, protected by holland. It was developed for use as glazing strip. Its job—(1) to provide a weathertight seal in aircraft turrets, windows, and lights; (2) to keep temperature changes and vibration from cracking, shattering, or crazing the plastic or glass.

But plane manufacturers found this glazing tape so versatile that it soon outgrew its name! Its adhesive coat speeded assemblies. Its compressibility and long-lived resilience made it suitable for gasketing, for binding wire clusters, for lining harnesses, and for other purposes. Today, one prominent builder of bombers is using this tape in more than fifteen applications—including cowling strips, harnesses, and firewall discs.

This Armstrong's Cork-and-Sponged-Rubber Composition is available in continuous lengths up to 100 ft., 1/16 in. or 1/8 in. thick, from 1/4 in. to 32 ins. wide; also in sheets and in special cut pieces. It is supplied with or without adhesive coating.

If you would like a sample of this tape—or of any of the specialized Armstrong Aircraft Materials listed below—write Armstrong Cork Co., Industrial Division, 1511 Arch St., Lancaster, Pa.

ARMSTRONG CORK COMPANY

Aircraft Materials

- Gaskets, packings, seals, piston cups, bushings, and valve seats—for gauges, meters, fuel lines, hydraulic systems, and other aircraft equipment
- Composition roll goods, with or without fabric back, plain or adhesive-coated—used as glazing strip, binding tape, cushion pads, anti-skid flooring, and gaskets
- Tank strap cushions
- Sealing materials for equipment handling aromatic fuel
- Felts for vibration-damping and soundproofing
- Wingwalk materials; Airoflor (lightweight flooring)
- Carburetor floats and other fabricated cork specialties

GRAND CENTRAL AIRPORT

We read of mock-ups of planes designed to carry more passengers than a streamlined train. We hear of a mammoth dam being built in the frozen north—all materials and men transported by air. We hear of so many soldiers being transported so far in so many planes. The complete facts are military and corporation secrets. But one fact is plain:

As new planes are designed and built, more and more OSTUCO seamless steel tubing is required—for engine mounts, fuel lines, shaft and door assemblies, fuselage and stabilizer frames, landing gear parts, pontoon supports—for many parts where flexibility, machinability and the strength-weight factor are important. OSTUCO is war-geared to keep pace with changing design requirements for military construction. The experience thus gained will be placed at your disposal for quality production and prompt delivery of OSTUCO seamless steel tubing for the peacetime transport and passenger planes you are planning to build.

LET'S NOT FORGET: Buy more bonds and stamps • Get in the SCRAP • Be on the job every day • Write to the men in service.

THE OHIO SEAMLESS TUBE COMPANY

MANUFACTURERS OF SEAMLESS AND ELECTRIC-WELD STEEL TUBING

SHELBY OSTUCO OHIO

WASHINGTON In Formation

RICHARD E. SAUNDERS
Washington Correspondent

LOOKING ahead to 1944, it seems a safe bet that aviation is going to be emphasized more than ever before. This may seem like a tall statement in view of the fact that air power has not been exactly minimized heretofore. But only a brief scanning of the various governmental fronts—legislative, administrative, and military—serves to justify the prophesy. Recent developments have focused Congressional attention on the broad aspects of air navigation with renewed intensity. Military authorities have revealed that a large part of their 1944 procurement program will center around aircraft. Administrative agencies are preparing to get down to cases in licking aircraft production problems. Finally, legislative and executive committees and boards are showing increased interest in devising workable plans for promoting aviation development during the post-war period.

Globe-Girdling Senators Learn Some Things

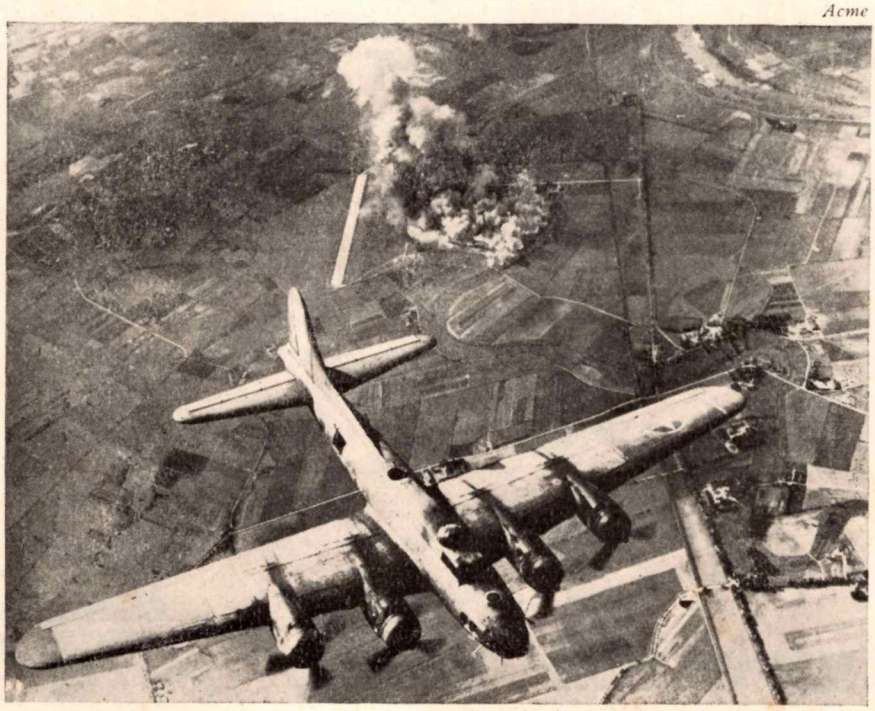
For its part, Congress was jolted into a new realization of what air navigation means by the flying Senatorial mission to world battle-fronts. In a four-engined *Liberator* transport the five Senators covered 41,000 miles and visited theatres of military operations in Britain, the middle east, and the southwest Pacific with stopovers in India and China. To thoughtful members of the Senate it seemed that the trip had been a good thing. The flare-up of controversy over bungling on the diplomatic front that it provoked only served to emphasize to them the need for more realistic foreign policies.

Differing in some of their views, all five of the Senators who made the observation tour seem to agree that while we have a first class fighting team on all of the fronts, those we have sent abroad to economic and diplomatic posts are with few exceptions the rankest sort of amateurs. They also directed criticism at policies which apparently freeze American air commerce out of air fields constructed throughout the world with American labor and capital. Still another matter commented on was the surprising amount of sentiment among senior officers of both the Army and Navy for a single Department of War with autonomous land, sea, and air services.

While it has finished with the business before it this session, Congress is going to probe into some of the questions raised by the globe-circling Senators when it comes back in January. In fact, charges of abuses in connection with the administration of the lend-lease program have already resulted in the launching of an investigation by the Truman Committee. But there seems no doubt that the main result of the trip is to make Congress more aware of the fact that for better or worse we are going to have to play a hand in the great game of international politics. Since this is apparently necessary to win the peace and stabilize the world thereafter, the demand is growing that we have a team of first class poker players in the game and, even more important, that Congress get busy and evolve some fundamental guiding policies.

A surprise raid carried out by "Flying Fortresses" on Oct. 9th, left the huge Focke-Wulf aircraft factory at Marienburg, Germany, in flaming ruins

Acme

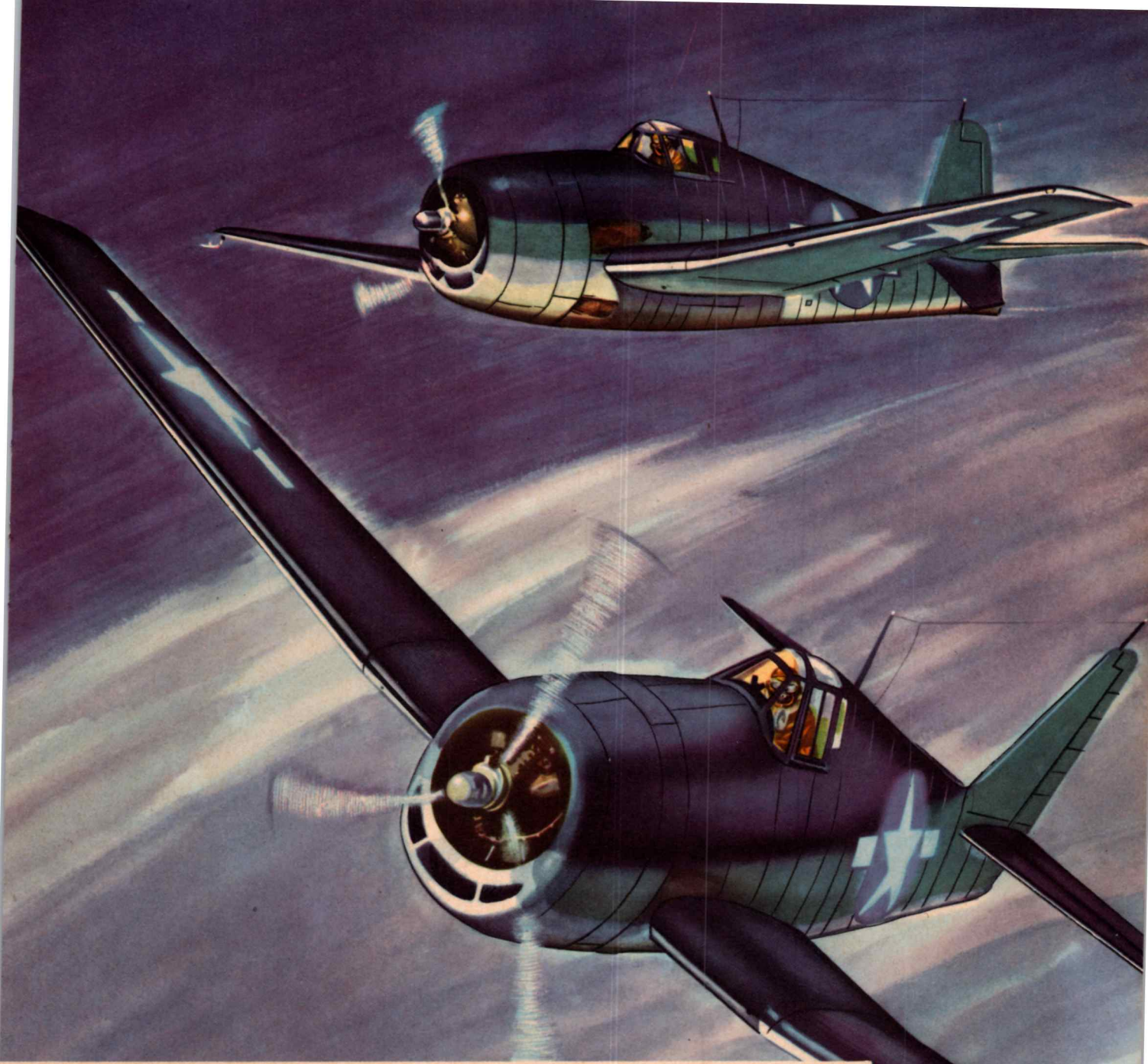


Separate Air Force Nearer

Advocates of a united air force both in Congress and elsewhere believe that they are getting nearer their goal, even though the President has squelched requests for what he terms a "drastic" change. Encouragement is found in the fact that the President left the door open in discussing the subject. He did not flatly oppose the creation of a separate air force but merely took the position that a complete reorganization of the services at this time might seriously disrupt the war effort. Also it is believed significant that he did not rule out a gradual step-by-step reorganization of the services to give aviation greater autonomy.

Still another trend looming on the Congressional horizon is to be detected in a growing demand for reductions in federal expenditures. There seems no doubt that an economy wave will break in full force when the new

(*Continued on page* 133)



The B.F. Goodrich Airplane of the month

GRUMMAN HELLCAT

WATCH THE HEADLINES as the name "Hellcat" is written into the history of this war. You'll read it, and it will be good reading . . . for everyone but the Axis. For this sensational Grumman fighter—designated F6F—is our Navy's newest form of sudden death with wings. It's at home on land or on a carrier's deck. And like its famous predecessor, the "Wildcat," this new speedster will also be one of the British Navy's standard fighters.

We're proud that Silvertown Tires, De-Icers, Bullet Sealing Fuel Cells, and many other B. F. Goodrich products are helping manufacturers like Grumman make American warplanes the best in the world. To one of these planes, the Grumman "Hellcat," —our nomination as Plane-of-the-Month.

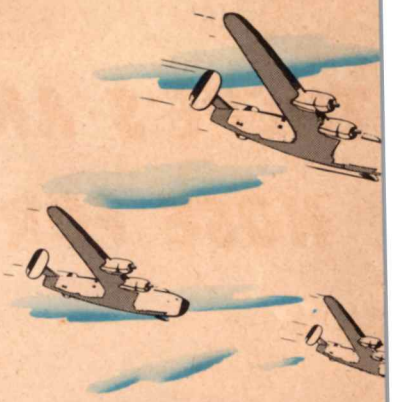
In war or peace

B.F.Goodrich

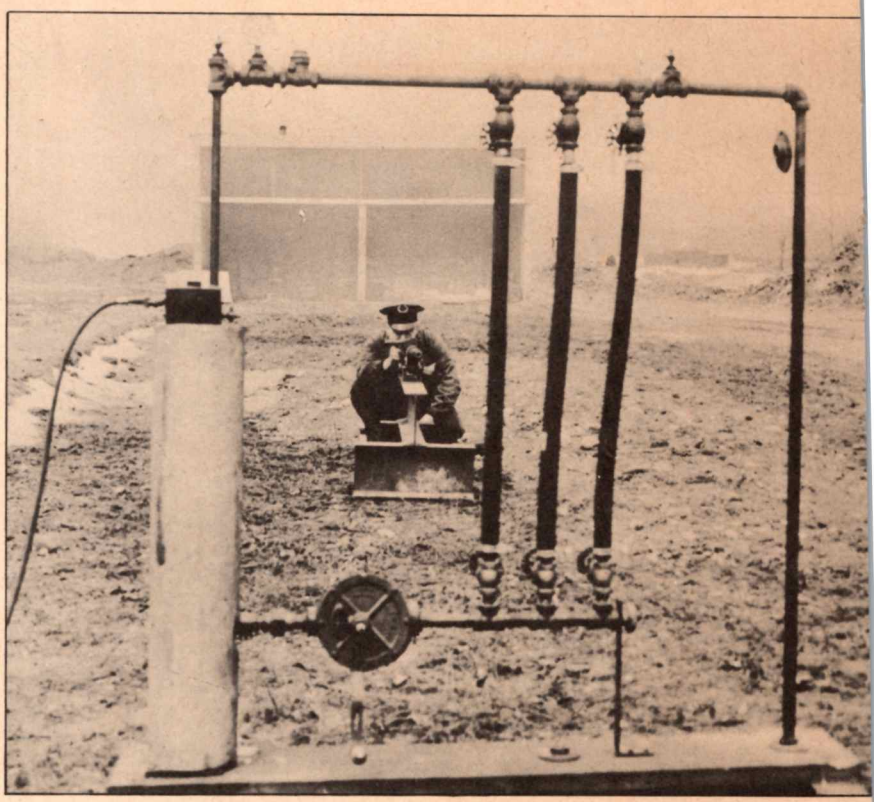
FIRST IN RUBBER

DICK LOOMIS

B.F. GOODRICH RUBBER RESEARCH FOR THE *Aviation industry*



HE'S SHOOTING HOLES IN A HOSE . . . TO HELP BRING OUR FIGHTERS HOME



IT'S A mighty important hose he's shooting at, and it's mighty important that he score plenty of hits. For this hose is the vital link between an airplane's fuel tanks and its engines . . . a link whose failure due to bullet punctures, shell fragments, or any other cause could mean the loss of plane and crew. That's why he wants his 50 calibre bullets to hit and hit again . . . to see if the hose can take it.

And it can. This newest type of B. F. Goodrich Bullet-Sealing Fuel Hose has stood the firing tests both on the range and in combat. Time and again it has been shot up by 30's and 50's without fuel leakage. Actual cases are on record where good sized shell fragments have been found imbedded in the fuel hose of planes safely home from battle.

Back in 1941 was when B. F. Goodrich first began producing bullet-sealing fuel hose . . . following many months of development work. The original construction consisted of an Ameripol (synthetic rubber) tube, sealing layers, reinforcing plies, and an Ameripol cover. When gasoline penetrated the tube through any puncture, it caused the sealing layers to swell and thus seal the puncture.

Much research and many more developments followed, due to constantly changing performance requirements. The advent of aromatic fuel was responsible for one of the recent developments. This new fuel caused greater swelling and deterioration of the tube compound, hence construction utilizing an aromatic-resistant compound was needed. The first one developed did an excellent job of sealing at normal temperatures; but at the sub-zero temperatures encountered in arctic and high-altitude operations, its sealing effectiveness diminished.

It therefore became necessary to develop still another construction utilizing a compound that would swell enough at sub-zero temperatures to seal efficiently yet not swell so much at normal temperatures that the inside diameter would be severely restricted. A construction of this type, with a few minor changes, has been in production since early 1942.

It is interesting to note that over 300 different constructions were made up and subjected to firing tests before today's efficient B. F. Goodrich Bullet-Sealing Fuel Hose was produced. And even now, B. F. Goodrich engineers continue their research, looking for still greater sealing efficiency . . . still greater protection for our combat fliers all over the world.

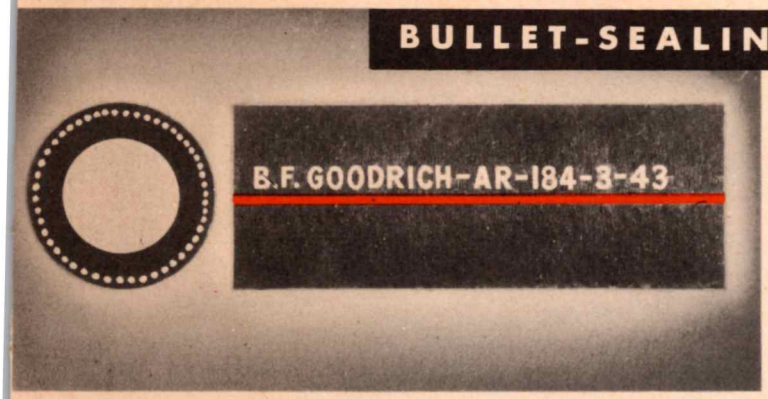
MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

ARMY E NAVY

Awarded to seven plants

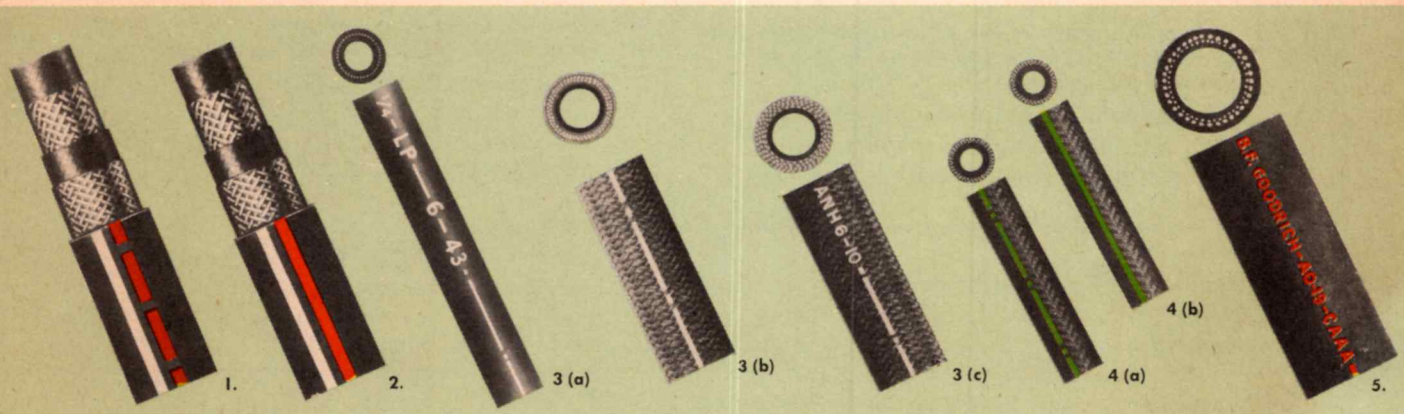
THERE'S AN EFFICIENT B. F. GOODRICH HOSE FOR EVERY AIRCRAFT APPLICATION

BULLET-SEALING FUEL HOSE



SCHEMATIC CROSS SECTION drawing of basic elements and side view showing identification markings. Designed for maximum sealing efficiency, this hose meets latest Army and Navy requirements and is approved for Army and Navy aircraft.

HERE'S PROOF of sealing efficiency: Although this small section of hose was punctured four times by .50 calibre machine gun bullets (shown in same scale below) it held fuel under 10 to 15 pounds pressure without leaking.



ALL B. F. GOODRICH HOSE CLEARLY MARKED FOR QUICK IDENTIFICATION

1. AIRCRAFT HOSE: All-purpose hose suitable for fuel systems. Meets latest revisions of Army-Navy specification AN-ZZ-H-456A. Identified by one broken red and one solid white stripe.

2. OIL AND COOLANT HOSE: Made with new Neoprene compound to meet coupling conditions encountered in oil and coolant service. Otherwise similar to (1) above. Solid red and solid white stripe.

3. (a, b, c) **HYDRAULIC AND INSTRUMENT HOSE:** (Note: This group compounded for use in working conditions as low as –70° F. Identified by code ·–·– as B. F. Goodrich low temperature resistant.)

(a) **SPEC. ANZZH626A LOW PRESSURE INSTRUMENT HOSE:** For use on air, hydraulic, low pressure and fuel lines up to 40% aromatic.

(b) **SPEC. ANZZ623A HIGH PRESSURE HOSE:** Available both in synthetic and braided cover.

(c) **SPEC. ANH6a MEDIUM PRESSURE HOSE:** Air Corps standard for both medium and high-pressure service.

4. OXYGEN BREATHING HOSE: (a) Low Pressure—broken green stripe; (b) High Pressure—solid green stripe.

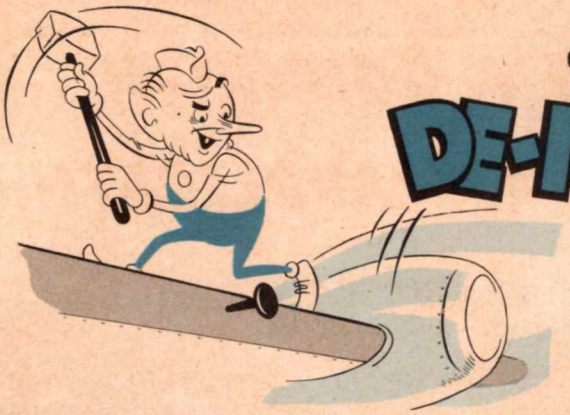
5. FIRE PREVENTIVE HOSE: For use ahead of engine fire wall in commercial planes. CAA-approved. Aromatic-resistant.

NEW DATA SHEETS AVAILABLE: Contain the facts you'll want (sizes, thicknesses, weights, lengths available, etc.) on the complete line of B. F. Goodrich Airplane Hose. For your free copy, write today (on company letterhead, please) to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

In war or peace

B.F.Goodrich

FIRST IN RUBBER



GEORGIE GREMLIN WASHED OUT ON THIS

DE-ICER SERVICE QUIZ

CAN YOU SCORE 100%?

Complete the ten statements by simply picking the one correct part (a, b or c) following each numbered statement. See if you can get them all.

1. During every preflight inspection, De-Icers should be checked for punctures, loose patches and for freedom from oil because . . .

a. The crew chief says so.
b. Punctures admit too much sunlight.
c. It insures successful operation.

2. Soapstone or talc is applied between the De-Icer and wing skin . . .

a. To act as an insulator.
b. To fill in cracks.
c. To act as a lubricant.

3. Any oil found on De-Icers should be removed as soon as possible with a neutral soap and water solution because . . .

a. De-Icers don't need outside lubrication.
b. Oil is extremely harmful to rubber.
c. Someone might slip and break his neck.

4. If any damage to the De-Icer—large or small—is discovered . . .

a. Find out who caused the damage.
b. Make sure the hydraulic system is full.
c. Ground plane until De-Icer repair is made.

5. Except in emergencies, the standard B.F. Goodrich De-Icer Repair Kit should be used for surface breaks whose length is . . .

a. Three-quarters of an inch or less.
b. Three inches or less.
c. Five inches or less.

6. Only the materials in the B. F. Goodrich De-Icer Repair Kit should be used because . . .

a. De-Icers must be repaired with specially compounded rubber.
b. These materials are gremlin-proof.
c. Other materials are more expensive.

7. Whenever possible, a vulcanized repair is best for large surface breaks because . . .

a. A vulcanized repair uses less rubber.
b. It is stronger, neater and lasts longer.
c. It can be done quicker.

8. Adhesive tape is applied to the underside of each fairing strip's trailing edge to . . .

a. Prevent marring the skin of the airplane.
b. Carry inspection data.
c. Show manufacturer's code number.

9. For most efficient operation, the De-Icer pressure gauge should read 8 lbs. per sq. in. because . . .

a. This pressure keeps the plane balanced.
b. This pressure keeps oil flowing freely.
c. This pressure is necessary for proper inflation of the tubes without danger of rupture.

10. A complete cycle of De-Icer inflation should take approximately 40 seconds because . . .

a. Perfect timing shakes off chisel-jawed gremlins.
b. A 40-second cycle permits ice to form and be cracked off most efficiently.
c. A faster cycle might cause wing flutter.

WHAT IS YOUR SCORE?

Each correct answer counts 10. 1-c, 2-c, 3-b, 4-c, 5-a, 6-a, 7-b, 8-a, 9-c, 10-b.

FREE! Pocket-size booklet on De-Icer Servicing and Installation! Every trainee and instructor who works with De-Icers will want a copy of this interesting and informative booklet. Completely illustrated with step-by-step drawings, it shows the correct procedures for removing, repairing, storing and re-installing De-Icers. For your free copy of "De-Icer Service and Installation," write today to the B. F. Goodrich Company, Akron, Ohio.

B. F. GOODRICH, AERONAUTICAL DIVISION, AKRON, O.

Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

WASHINGTON IN-FORMATION

(*Continued from page* 128)

session convenes in January. Several factors are responsible. In the first place, Congress has been made particularly sensitive to uncontrolled spending because of the necessity for levying new taxes. It has refused to swallow the Administration's proposal for raising $10,500,000,000 in additional revenue largely through drastically increased taxes on corporate earnings and on individuals in the middle income brackets.

The prevailing view is that such a huge new tax burden would be more than the country could stand and that a whittling down of expenditures would help ease the Treasury's hunger for new funds. Also it is felt that to the extent that additional revenue is necessary, some better method of distributing the load can be found—a sales tax for example. There is no disposition to scrimp on essential war expenditures but there is a manifest determination to squeeze the water out of future army and navy appropriations. Non-war appropriations will be handled even more roughly.

Spending for Air Power

It should not be thought that the penny-pinching mood of Congress constitutes a threat to the aviation program. Quite the reverse. It is simply that there is a general belief that the money should be spent where it will do the most good and that other programs should be tapered off as the situation changes. One illustration mentioned in this connection concerns escort vessels. It is contended that since the submarine menace has been pretty well licked there is no longer any need for turning out additional destroyers and vessels of the corvette type in large numbers. On the other hand, air power has the strongest kind of backing on Capitol Hill.

In an effort to skirt around opposition, the Lea bill proposing basic amendments to the Civil Aeronautics Act of 1938 has been split into two separate measures. Latest indications are, however, that this attempted end play to speed some kind of legislation through may only result in a loss of ground. The strategy was to do a little hasty surgical work and remove from the bill the section double-riveting CAB's power to bar surface carriers from the field of air transportation. Minus this provision which has provoked so much squawking it was felt that the rest of the bill would stand a better chance on the floor. The offending language was written into a separate bill and safely pigeonholed.

But even the less controversial version drew opposition. No sooner had the bill been reported out of the House Interstate Commerce Committee in its shorter form than a sizzling minority report was issued by dissenting members contending among other things that air transportation should be opened to "all comers" including surface carriers. In other words, the repeal of even the present rather generally defined prohibition against the issuance of operating certificates to competing land or water carriers was advocated. In addition, the minority report stresses the need for retaining state control of intra-state air commerce. Representative B. Carrol Reece (Rep. Tenn.) has introduced a bill embodying the proposals of the minority group.

Expanding on their views as to the necessity of securing greater competition in air commerce, the dissenting members of the House Interstate Commerce Committee have made the charge that the present business is monopolized by "a few large air lines". In this connection, the report they filed states that "emphasis on aviation as a national business protects the big transcontinental or partially transcontinental lines now operating against competition, whether from existing smaller lines or from newcomers." A quotation from a speech by C. Bedell Monro to the effect that "eighty-one per cent of domestic air transportation in this country is done by four companies and the remaining 19 per cent by fifteen companies" is included in the report. As a result of all of these fresh objections, the Lea bill and its companion measures are more hopelessly bogged down than ever.

House Approves Air Investigation

Faring somewhat better, a short resolution sponsored by Representative Bulwinkle (Dem., N. C.) authorizing the House Interstate Commerce Committee to make a general investigation of the field of air transportation and to recommend development programs for the post-war period, was approved by the House. It was only sidetracked briefly to permit a few members from

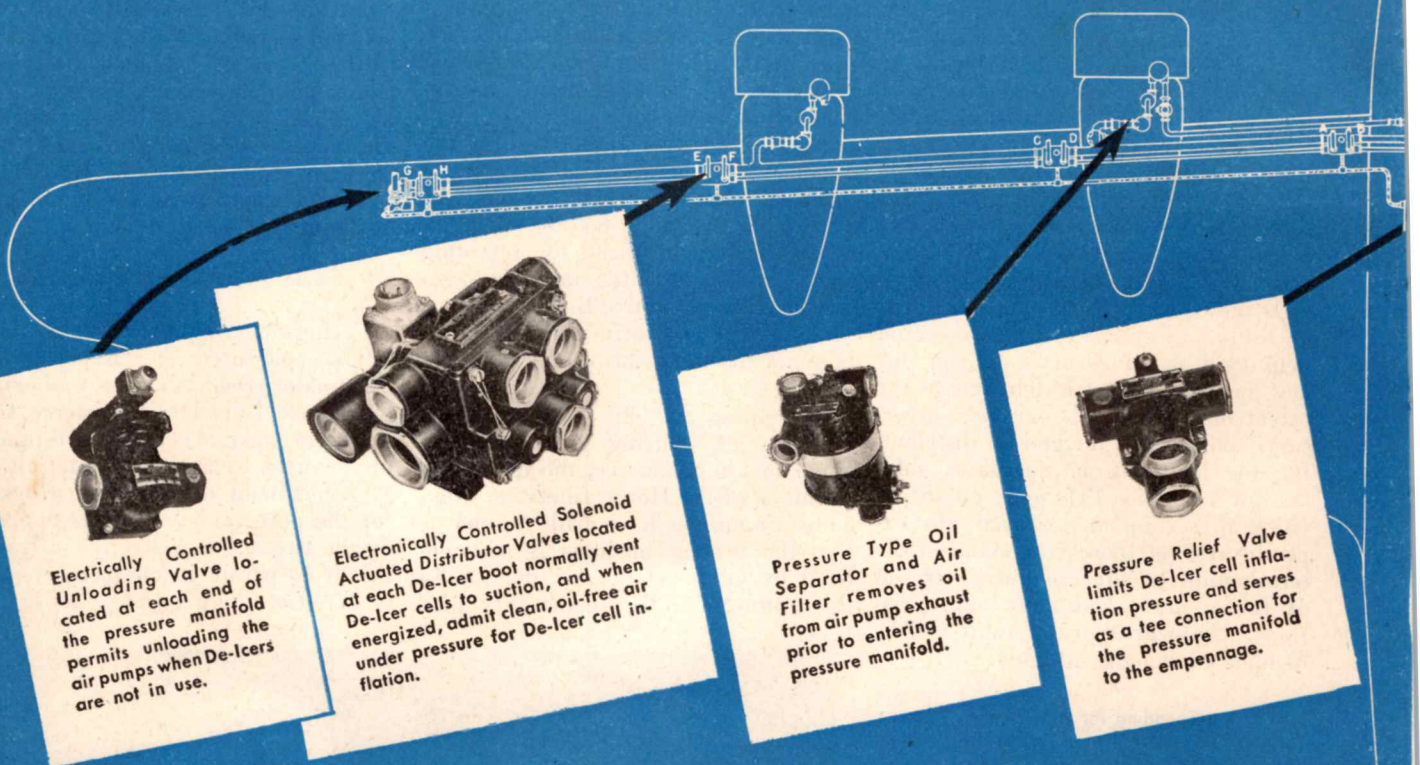
(*Continued on page* 286)

British Combine

New 20 by 30 ft operations map at British Coastal Command Headquarters. Movements of convoys and their escorts, aircraft sightings of U-boats or enemy vessels, and positions of British submarines are plotted on the map by means of symbols

MANIFOLD DE-ICER SYSTEM.

. . . provides controlled inflation and deflation of De-Icer boots



Electrically Controlled Unloading Valve located at each end of the pressure manifold permits unloading the air pumps when De-Icers are not in use.

Electronically Controlled Solenoid Actuated Distributor Valves located at each De-Icer boot normally vent De-Icer cells to suction, and when energized, admit clean, oil-free air under pressure for De-Icer cell inflation.

Pressure Type Oil Separator and Air Filter removes oil from air pump exhaust prior to entering the pressure manifold.

Pressure Relief Valve limits De-Icer cell inflation pressure and serves as a tee connection for the pressure manifold to the empennage.

Design Check Chart for Eclipse Manifold-Solenoid De-Icer System — Electronically Controlled

APPLICATION

To effect complete ice removal by the De-Icer method, accretion of ice must be permitted to develop a tensile strength sufficient to overcome adhesion between ice and inflated boot. The De-Icer system must accordingly be controlled for both rate of accretion and texture of ice formation. ***The Eclipse*Electronic De-Icer Control has been developed to accomplish this.***

The Eclipse Manifold-Solenoid De-Icer System with Electronic De-Icer Control in conjunction with B. F. Goodrich De-Icers installed on aircraft with wing spans in excess of 100 feet, provides a variable means of controlling frequency and duration of De-Icer operating cycles to suit any type and rate of ice formation.

PERFORMANCE

Provides a visible ***automatic*** or ***manual*** remote electrical control of wing and tail De-Icers.

Primary variable selector control permits variation of time between operating cycles to compensate for variations in rate of ice formation.

Secondary variable selector control permits variation of De-Icer cell inflation to compensate for variations in texture of ice formations and pump output during high altitude operation.

Push-button control permits manual operation of any individual De-Icer cell or cells when required.

DESIGN

Single span-wise ***suction and pressure manifolds*** provide a simplified, light-weight installation with negligible line losses. Pressure manifold acts as a reservoir, providing rapid and complete inflation of large boot sections.

Location of ***solenoid distributor valves*** adjacent to De-Icer boot connections also aids sudden and complete inflation of De-Icer cells.

Electronic timer permits variance of De-Icer inflation periods to correspond to individual De-Icer cell capacity, assuring complete inflation of all De-Icer boots.

Individual illuminated push-buttons permit manual operation of system independent of electronic relay. They also enable flight crew to determine proper functioning of De-Icer system at a glance.

De-Icer cells ***return to the deflated position*** in the event that pressure system, electrical system or any individual component becomes inoperative.

Current consumption is less than 6 amperes.

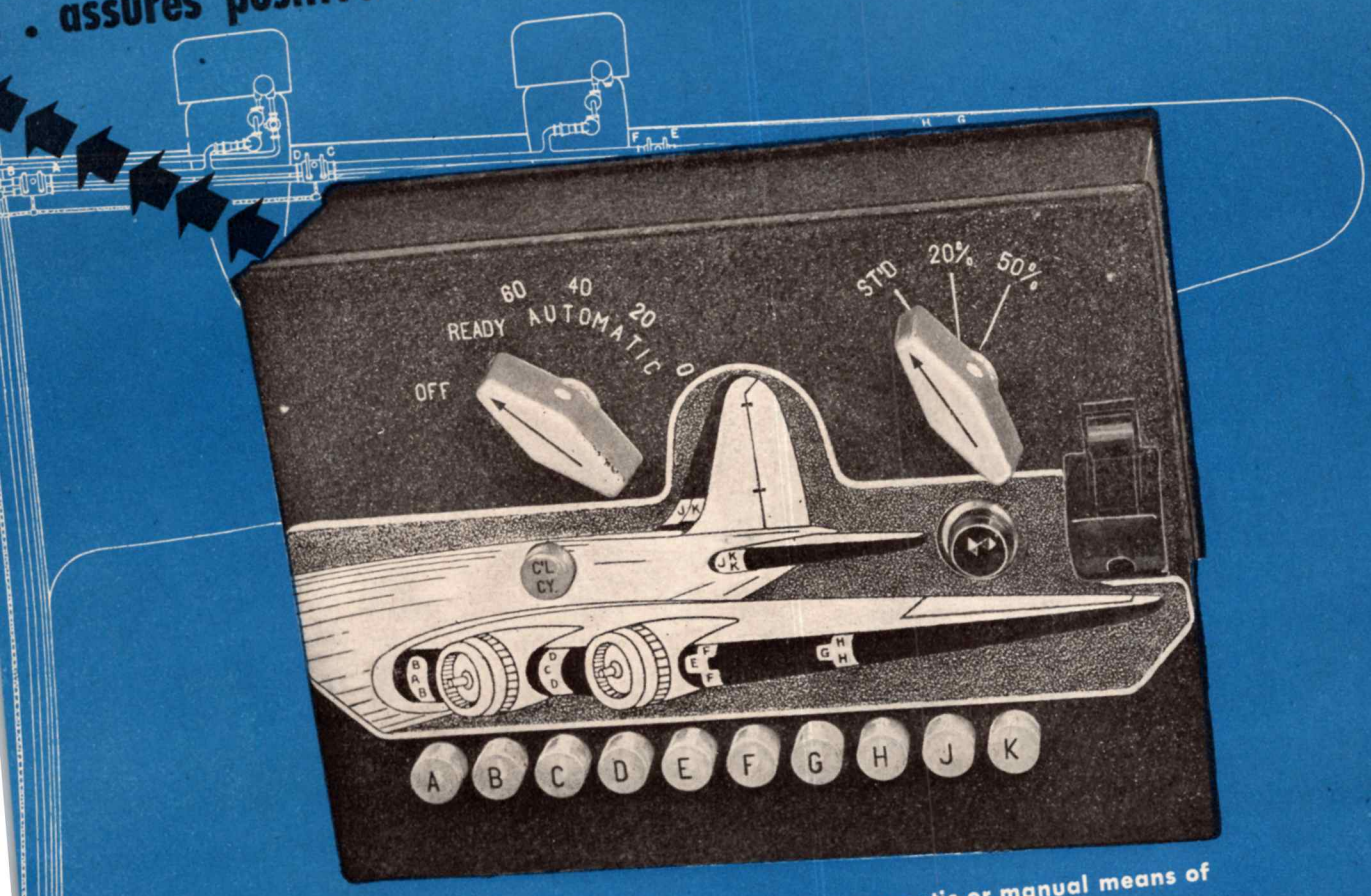
*TRADE MARK OF BENDIX AVIATION CORPORATION

Eclipse AVIATION ACCESSORIES

ECLIPSE-PIONEER DIVISION • Teterboro, New Jersey

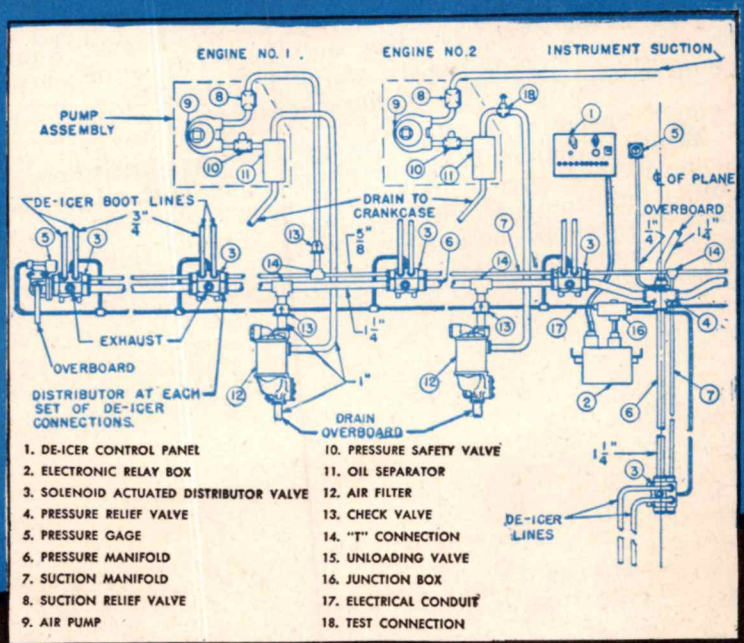
LECTRONICALLY CONTROLLED

. assures positive ice removal under all flight conditions



The *Electronic De-Icer Control* provides an automatic or manual means of controlling the frequency and duration of De-Icer operating cycles.

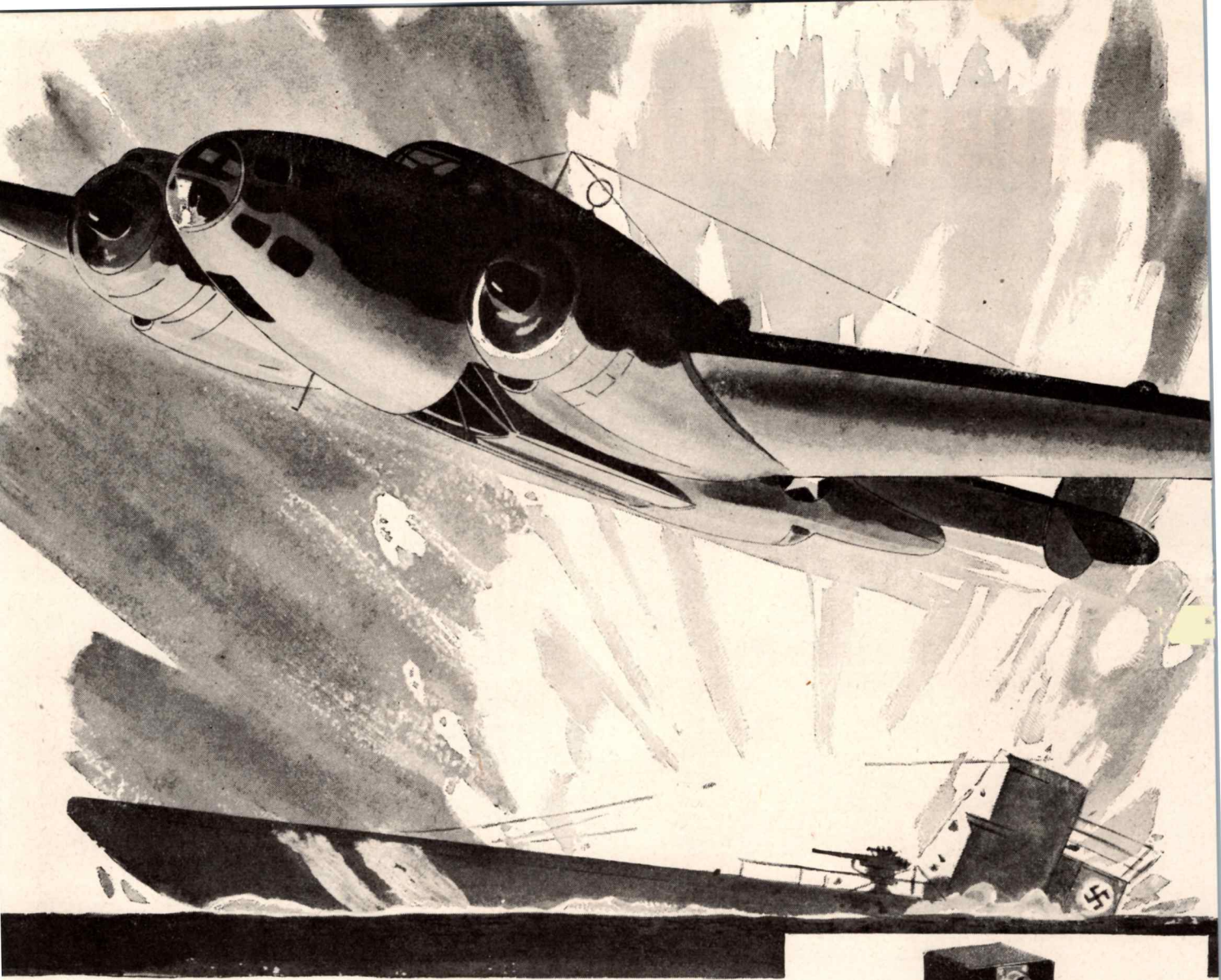
Schematic diagram of a typical Manifold-Solenoid De-Icer installation with Electronic Control.



1. DE-ICER CONTROL PANEL
2. ELECTRONIC RELAY BOX
3. SOLENOID ACTUATED DISTRIBUTOR VALVE
4. PRESSURE RELIEF VALVE
5. PRESSURE GAGE
6. PRESSURE MANIFOLD
7. SUCTION MANIFOLD
8. SUCTION RELIEF VALVE
9. AIR PUMP
10. PRESSURE SAFETY VALVE
11. OIL SEPARATOR
12. AIR FILTER
13. CHECK VALVE
14. "T" CONNECTION
15. UNLOADING VALVE
16. JUNCTION BOX
17. ELECTRICAL CONDUIT
18. TEST CONNECTION

THE INVISIBLE CREW

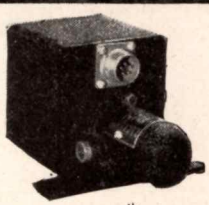
Precision Equipment by **Bendix Aviation Corporation**



OUTWITTING THE WOLF PACK

Sworn foe of the wolf pack is the Vega Ventura bomber, known to the Navy as the PV-1. This new and deadly submarine weapon has only recently gone into active duty, but it has already proved itself outstanding as an effective convoy guardian.

Helping to speed the deadly "ash cans" and torpedoes to enemy subs is Bendix Aviation, Ltd., Interphone Equipment which flies aboard the PV-1 as part of its Invisible Crew. With the life or death of Atlantic convoys in the balance, these radio controls must function with precision and reliability . . . always. *Bendix Aviation, Ltd., North Hollywood, California. Sales Engineering Offices in St. Louis, Dayton and New York City.*

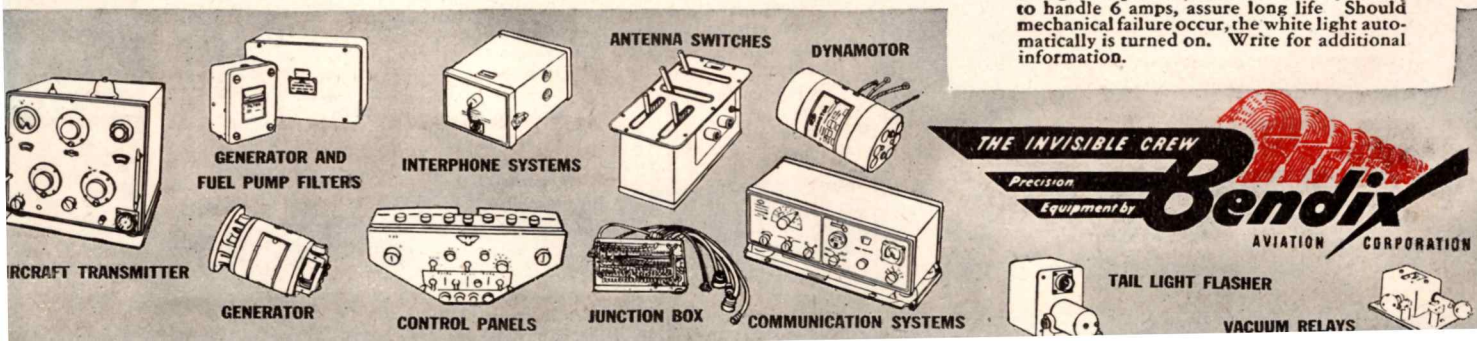


Bendix Aviation North Hollywood

SUBSIDIARY OF BENDIX AVIATION CORPORATION

RADIO EQUIPMENT

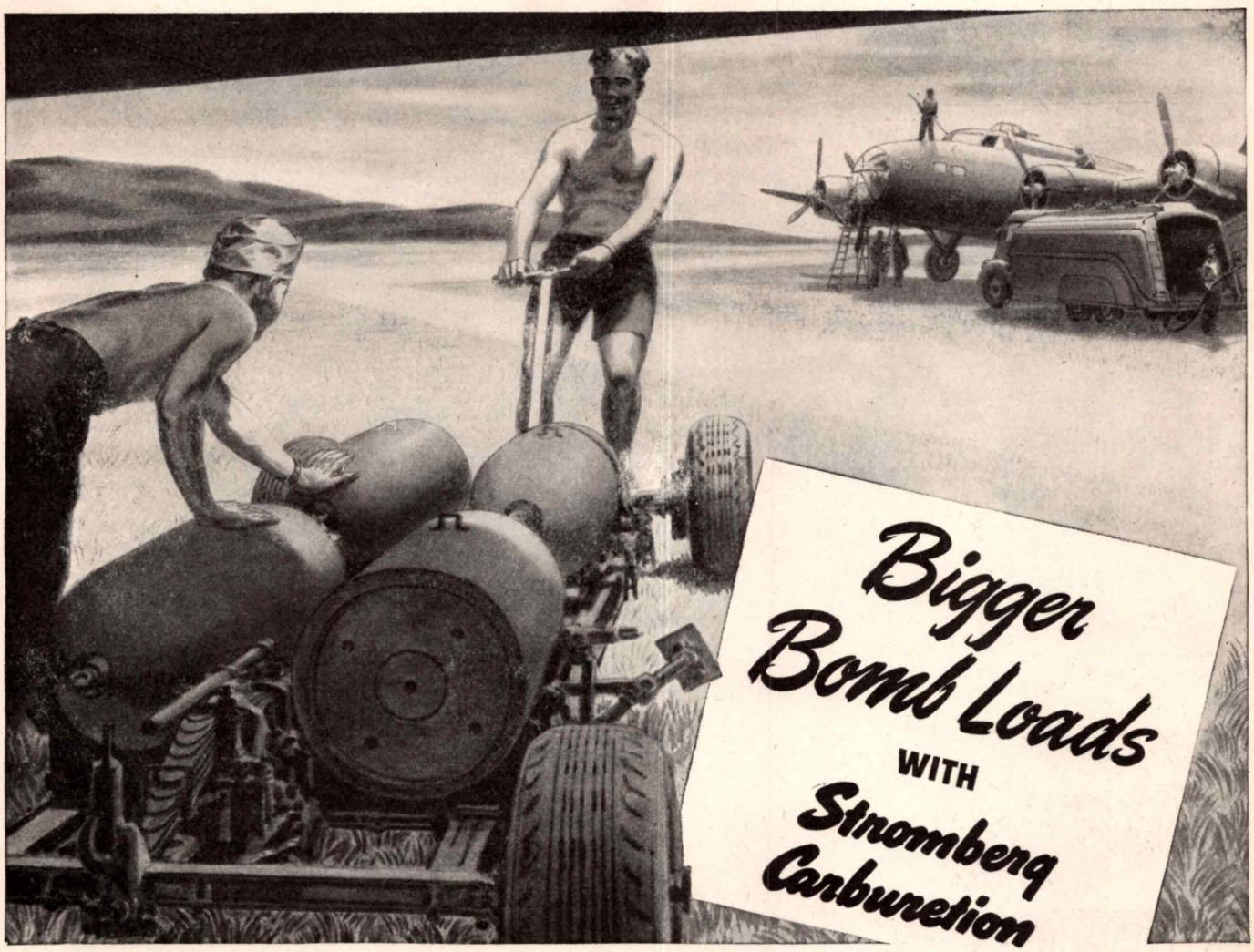
In addition to its military radio and electrical developments, Bendix Aviation, Ltd., builds other equipment for commercial use, including this Position Light Flasher, approved by the C. A. A. and now in service. The unit has been specially designed for aircraft and weighs but 2.1 lbs. 12- or 24-volt operation is provided. and the unit has been tested for operation down to -65° C. Accuracy of the flashing mechanism is maintained by a constant speed, compound wound, ball bearing motor. Tungsten points, conservatively rated to handle 6 amps, assure long life Should mechanical failure occur, the white light automatically is turned on. Write for additional information.



THE INVISIBLE CREW

Precision Equipment by Bendix

AVIATION CORPORATION



The *better fuel economy* and *accurate predictability of fuel consumption* that are possible with Stromberg Injection Carburetion mean more "block busters" per trip to soften enemy resistance and bring a quicker Victory.

Pressure atomization of gasoline, plus *automatic metering* of fuel at all engine speeds and loads also helps to give America's long range bombers amazing maneuverability and fighting power. For the Stromberg* Injection Carburetor assures correct fuel mixtures under *all* conditions of flight, independent of altitude, airplane attitude, propeller pitch or throttle position.

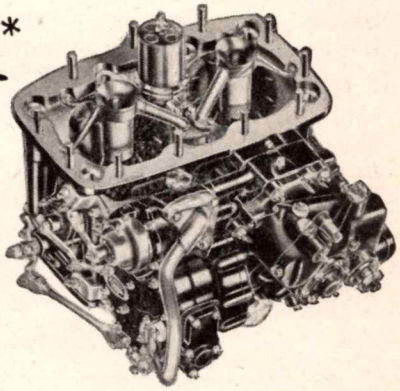
**Trademark of Bendix Aviation Corporation*

On fighter planes as well as on giant bombers and transports, Bendix-Stromberg Carburetion assures *constant* power flow, maximum fuel economy and greatly reduces *icing hazards.*

Stromberg*

INJECTION CARBURETOR

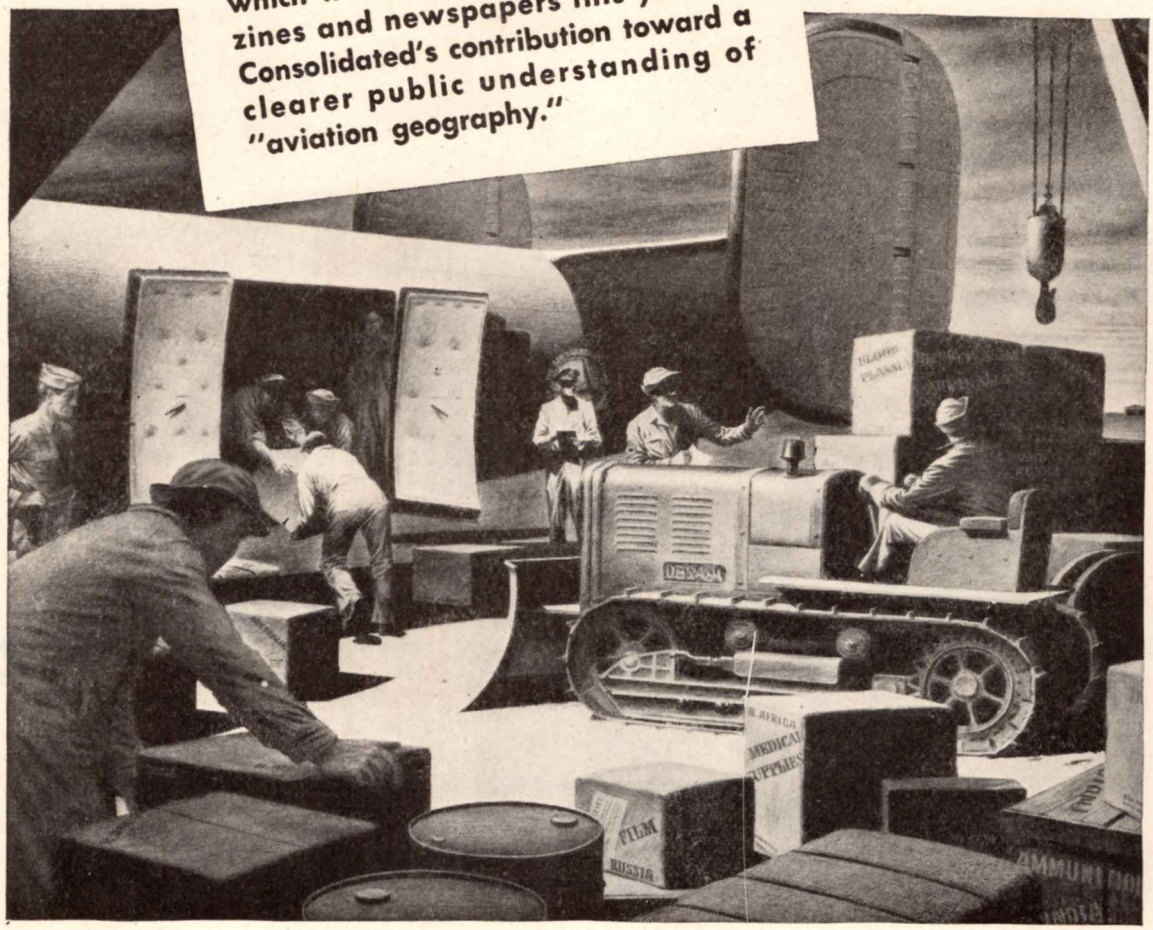
The Stromberg Aircraft Carburetor is an important member of "The Invisible Crew" . . . precision instruments, and controls, which Bendix plants from coast to coast are speeding to our fighting crews on world battle fronts.



THE INVISIBLE CREW
Precision Equipment by Bendix
AVIATION CORPORATION

BENDIX PRODUCTS DIVISION
of Bendix Aviation Corporation
South Bend, Indiana

This advertisement is one of a series which will appear in national magazines and newspapers this year as Consolidated's contribution toward a clearer public understanding of "aviation geography."



Snowplows in the sky

ONLY A YEAR OR SO AGO, air-minded men used to talk about hauling tons of freight by air – someday.

Today they are doing it.

The great planes of the Air Transport Command are flying the global skyways with tons of *everything* our world-based fighting men need so badly – even snowplows for blizzard-locked Alaskan airports, and complete gasoline trucks, cut in half for shipment and welded together again at their destination.

Cargoes flown, with destinations and flying time, have included medical supplies to North Africa, *27 hours* – bomb fuses to Britain, *17 hours* – aircraft engines to China, *37 hours* – blood plasma to Australia, *35 hours* – ammunition to India, *43 hours* – mail to Iceland, *13 hours* – precision tools to Russia, *24 hours.*

The whole story of the magnificent job these airmen are doing cannot be told until after the war. To tell it now – even if we could – would endanger the lives of men and reveal military strategy.

Today these trans-oceanic fliers are making schedules – not headlines. It's a routine job to them – flying each high-priority cargo to the spot where it will do *us* good and the Axis harm.

Often that spot is halfway around the world.

But to Air Transport Command pilots, *no spot on earth is more than 60 hours' flying time* from the military airports "somewhere in the U.S.A." from which they operate.

On their timetables these pilots clock off the Atlantic and the broad Pacific like locomotive engineers. One Liberator Express was in the air only 33 hours and 27 minutes from the time it left Australia until it came down in California. Another flew from Newfoundland to Britain in 372 minutes. And a pilot on the New York-Lisbon run recently made 12 crossings in 13 days.

So it's too late, now, to wonder when the Air Age will come. *It's already here.*

CONSOLIDATED VULTEE AIRCRAFT

And it's still too early for rash speculation about what the postwar years of the Air Age will be like. Our job today is to win the war so that there will *be* a postwar world worth living in.

But the impact of air supremacy in winning this global war points more clearly, every day, to this fact:

When Victory has been won, air power, in the hands of the freedom-loving nations of this 60-hour-wide world, can well become "the strong right arm of peace."

MERCATOR PROJECTION

Our old maps *do not always give us a true picture of the new "aviation" geography. If a Liberator Express pilot tried to chart a Washington-Chungking "great-circle" route on a Mercator projection* (above), *he would find that it disappeared off the top of the map!*

AZIMUTHAL EQUIDISTANT PROJECTION CENTERED ON WASH. D. C.

Maps like this *enable us to show great-circle airline routes from Washington to any spot on the globe as a straight line. Such a map can be drawn so that it is centered on your home town or any city.*

CONSOLIDATED VULTEE AIRCRAFT CORPORATION

San Diego, Calif. • Vultee Field, Calif.
Fort Worth, Texas • New Orleans, La.
Nashville, Tenn. • Wayne, Mich.
Allentown, Pa. • Tucson, Ariz.
Elizabeth City, N.C. • Louisville, Ky.
Dearborn, Mich. • Miami, Fla.

Member, Aircraft War Production Council

QUICK FACTS FOR AIR-MINDED READERS

10 planes an hour — *It is estimated that U. S. aircraft manufacturers are now turning out planes at a rate of about 1 plane every 6 minutes, around the clock, every day of the month.*

• • •

The danger of ice formations on airplane wings has been completely overcome, according to a statement by TOM M. GIRDLER, Chairman of the Board, Consolidated Vultee Aircraft Corp. This feat is accomplished by a new thermal anti-icer, pioneered by the N.A.C.A. and perfected by Consolidated Vultee. Hot exhaust gases now are used to keep all leading edges of the plane at a temperature well above freezing when icing conditions are encountered.

• • •

Teamwork for Victory — Consolidated Vultee was the first to build multi-ton bombers in volume production on a moving assembly line. To help maintain Allied air supremacy, the Consolidated-designed Liberator bomber is also being built by Ford, Douglas, and North American.

• • •

To speed production, more than 10,000 subcontractors and suppliers, in cities all over the U. S., are working to provide subassemblies, parts, and materials for the planes being built in the Consolidated Vultee plants.

• • •

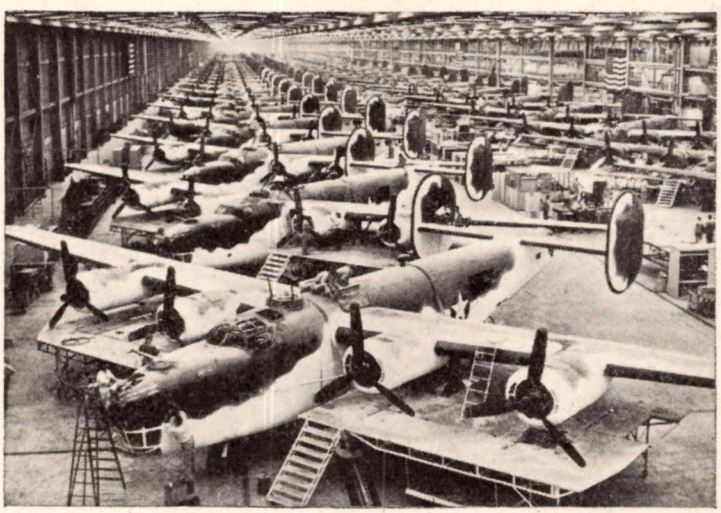
Tomorrow's fledglings—Elementary aeronautics is now being taught to students in more than 14,000 American high schools.

"Gone today, here tomorrow!" — *This 33-ton, 4-engine Coronado, under way for the take-off, has a range of over 3500 miles — can remain aloft a whole day at a time. Designed and built by Consolidated Vultee, this giant Navy patrol bomber is also in service as a cargo transport plane.*

• • •

Note to plane spotters—This is the new insignia for U. S. Army planes. The change provides visibility at 60% greater range, and overcomes confusion between our former insignia and the insignia used by Axis planes.

No spot on earth is more than 60 hours' flying time from your local airport



In their war paint — *Before Liberator bombers go to war, they are camouflaged and fitted with special equipment for the combat area where they will be operating.* Above: *White-bellied Liberators move down an assembly line in a modification plant.*

LIBERATOR (4-engine bomber) — CORONADO, CATALINA, (patrol bombers) — LIBERATOR EXPRESS (transport) — VALIANT (basic trainer) — VENGEANCE (dive bomber) — SENTINEL ("Flying Jeep") — RELIANT (navigational trainer)

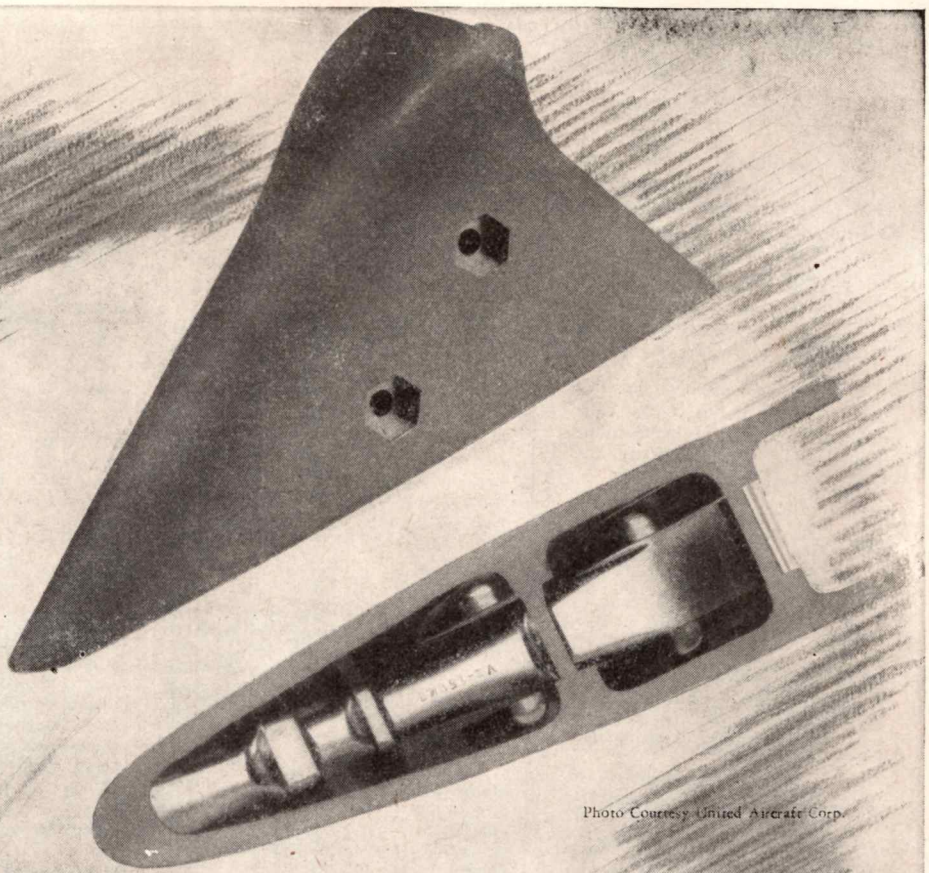


Photo Courtesy United Aircraft Corp.

BUILT TO TAKE IT

G-E flap hinge fairings are built to take it. Used on the Vought Corsair, the Navy's F-4U-1, these fairings are constructed to withstand the shock of ejected machine gun shells. Textolite fairings eliminate a difficult fabricating job thereby speeding essential production. This part is one of many supplied the aircraft industry by General Electric who also molds:

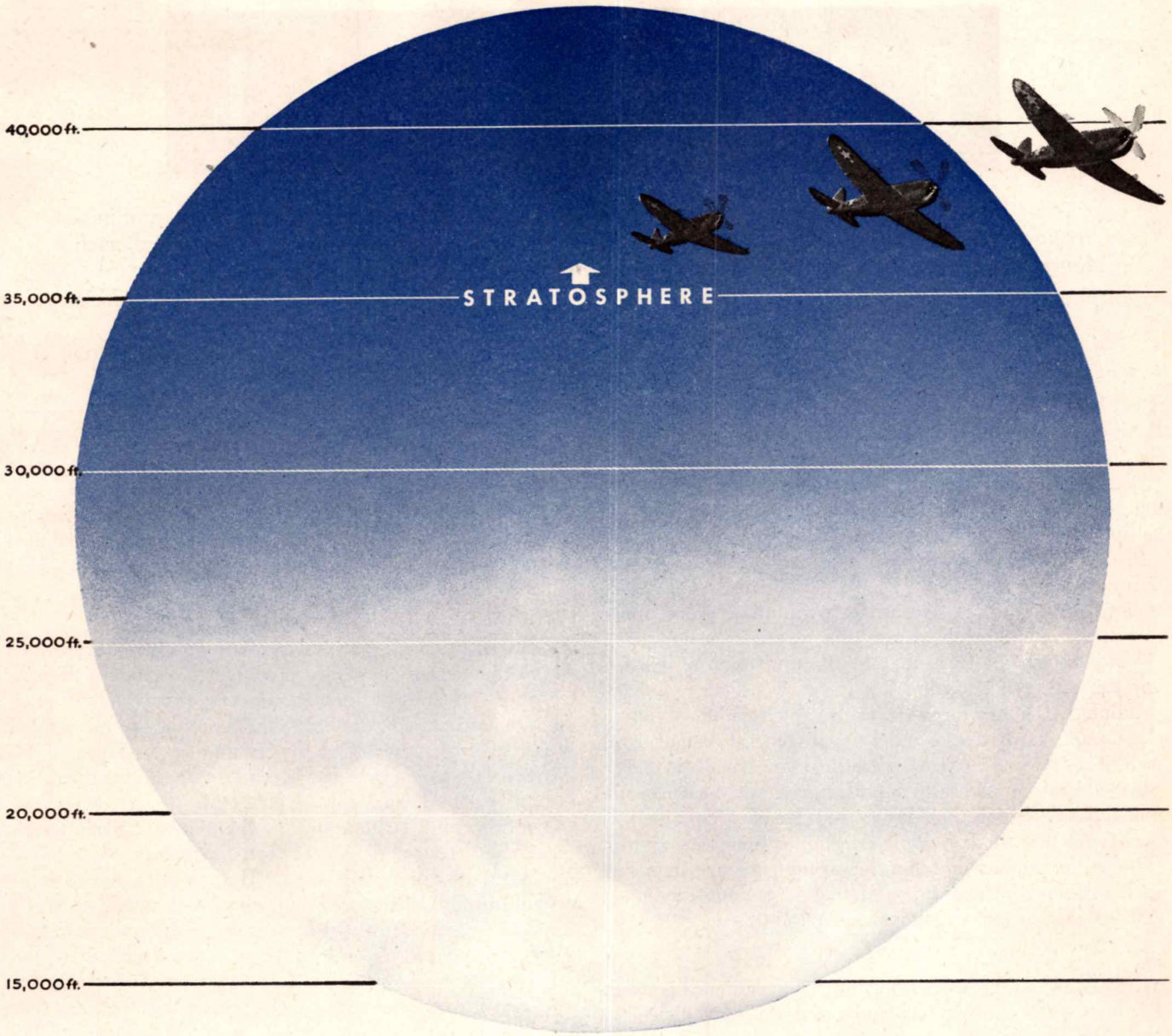
Instrument cases	Instrument panels
Terminal blocks	Terminal elbows
Spark plug terminal sleeves	Brush holder rings
Booster coil housings	Loop antenna housings

General Electric plastic materials meet the requirements of the specific war jobs for which they are formulated. For further information write section R-6, One Plastics Avenue, Pittsfield, Mass.

Hear the General Electric radio programs: "The G-E All Girl Orchestra," Sunday 10 P.M.–E.W.T. NBC. "The World Today" news every weekday 6:45 P.M.–E.W.T. CBS.

192,000 employees of the General Electric Company are on their jobs producing more goods and buying over a million dollars of War Bonds every week to hasten victory.

GENERAL ELECTRIC



"THUNDERBOLT-WORLD"

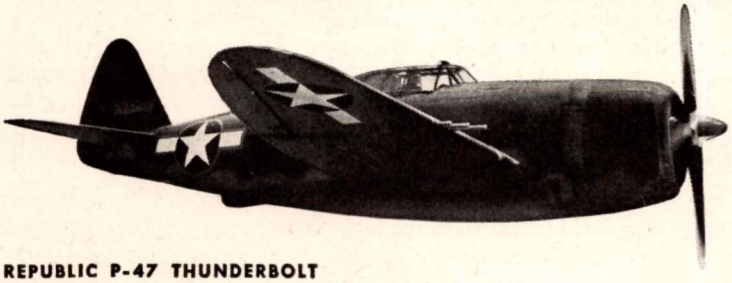
The "Thunderbolt" was conceived for one purpose . . . to fight in the Stratosphere.

There, over seven miles straight up where few other aircraft go, is the "Thunderbolt-World." Ordinary planes that perform brilliantly at lower altitudes, lose their speed and maneuverability as they approach the Stratosphere.

Up between thirty and forty thousand feet, the Thunderbolt flies at more than 400 miles an hour . . . spits sudden death from eight 50 calibre machine guns in its wings. It is a deadly weapon . . . guardian of our high-flying bombers.

Only by experience and scientific research in the Stratosphere and its effect on motors, parts, materials and man himself could such a plane have been engineered. Republic designers and Army Air Forces experts have a rare understanding of Strato-mechanics.

After the war, this knowledge will be used to speed up communication between nations . . . to bring the peoples of the earth closer together.



REPUBLIC P-47 THUNDERBOLT

REPUBLIC Aviation

FARMINGDALE DIVISION

SPECIALISTS IN HIGH-SPEED AIRCRAFT

EDITORIAL

"For nearly twelve years we have lived under the Presidency of one man and the administration of one group. Irrespective of the abilities or motives of the individuals involved, such long continuance of power is hazardous to the perpetuation of free government."

—Wendell Willkie

You Can't Abuse a Horse and Expect It to Do a Good Day's Work

A TERRIBLE responsibility rests upon the shoulders of those directing our aviation industry, both within the government and in management circles. Ultimate victory in this war depends upon our production of more and more aircraft; for, regardless of all other fighting equipment, if enough aircraft are not provided to maintain and increase Allied air dominance, we can't win. Grimly and in the face of impending ruin when peace comes, our industry's executives are putting every ounce of energy into the job of attaining production and more production—in the face, that is, of ruin because of existing tax and renegotiation laws.

Ralph S. Damon, former president of Republic Aviation Corp., and now vice-president and general manager of American Airlines, recently testified on behalf of seven of the Eastern aircraft manufacturers at hearings on renegotiation before the Ways and Means Committee of the House that "today, while depending upon the aircraft industry to produce our fighting planes, we are imposing such financial burdens upon it that it is doubtful that it will be able to survive the war."

THESE are strong words, but no stronger than his assertion that "by present tax and renegotiation policies, we are legislating the industry out of existence. . . . Unless we permit it to accumulate, during the war, reserves adequate for its eventual conversion to peace, the industry is faced with actual bankruptcy."

Reminds us of the shiftless and brutal farmer who abuses and underfeeds his work horse, and then expects the poor animal to do a good day's work in the field.

The recently-issued report of the Harvard School of Business Administration shows that the typical aircraft company owes the government over forty-nine and a half millions in taxes due and in refunds which must be made as a result of renegotiation of contracts, yet it has only tweny-nine and a fraction millions of quick assets to meet these obligations. In plain words, the typical concern is continuing in business only by pushing ahead its mounting debt to the government.

Some other figures are illuminating. In 1939 the industry paid the government 24.1 percent of its earnings in taxes; in 1942 it paid 73 percent. After taxes and renegotiation, composite figures for eleven typical aircraft companies showed a profit of 2.7 percent of sales for 1942. Even this profit may be fictitious, since it is reinvested in inventories for materials, manufactured parts, etc., which can only be realized upon in the finished airplanes.

Of the industry's net earnings in 1942, 77 percent was put back into the business, leaving only 23 percent to be distributed in dividends. Compare this with the average of ten large industrial corporations outside the aircraft field. For 1942 these ten put back 36 percent of earnings to continue their production operations, and distributed 64 percent as dividends. The aviation industry has been ultra-conservative in its dividend policy.

CONSIDER working capital in relation to inventory owned by the eleven companies investigated. Whereas the corporations outside the industry had working capital equal to 146 percent of inventories, the aviation group's capital was only 28 percent of its inventories. Thus, if its inventories had depreciated by less than one-third, its capital would have been wiped out.

On this point, Damon told the Committee: "Some people imagine that our inventories consist mainly of metal in the form of ingot and sheet. If that were the case we would have much less to worry about—although we would expect our metals to be of smaller value after the war than they are today. We might be able to absorb that sort of loss. It might not break us. But our inventories do not consist mainly of metals in crude form. Less than 20 percent of our total inventory is of that type. The vast majority consists of semi-finished and finished parts which, as I have said, cannot be adapted to peacetime use. The gravity of the situation is, therefore, obvious."

Aside from the industry's utter dependence upon the stability of its inventories, it is shown to have working capital with which to pay wages, salaries and material expenses for only two weeks of operation at the present rate of production. In other words, the eleven companies examined have average monthly operating costs of $24,752,000, whereas working capital to meet these costs averages only $12,555,000.

TOTAL assets of the eleven typical aircraft companies investigated aggregated $2,932,000,000, without taking any debts into account. Against these assets for which management of these companies has been made responsible, the total capital of the stockholders is a mere $238,000,000, or 8 percent. A decline of only 8 percent in asset value, therefore, would wipe out the entire investment of the stockholders.

Says Damon: "The industry has been forced into a degree of expansion made necessary by military requirements but completely unjustified (*Continued on page* 310)

S*porty says:

see ADEL *for quick service*

Plants in Burbank, California, and Huntington, West Virginia, will give you *immediate deliveries* of ADEL line support clips and blocks. They're the *standard* of the industry because ADEL pioneered in this field, designed, refined, simplified and improved . . . not for months but for *years*. Tested on every battle front, used by every major U. S. and Canadian aircraft company. Over 150 million now in service. 12,000 production types and sizes for all aircraft to save you money in simplicity of installation, long life, ease of maintenance, low cost upkeep.

Ask our nearest engineering service office for free catalog with authoritative information about the correct support for electric conduits, fuel, oil, instrument, and hydraulic lines. And if you hear claims that other line supports are "just as good" as ADEL'S, please bear in mind that it is always a safe bet to use what others *try* to imitate.

ADEL

PRECISION PRODUCTS CORP.

Burbank, California
Huntington, W. Va.

*S*PORTY SAYS:*
SUPPORT OUR BOYS
...BUY MORE BONDS

*S*PORTY is made of standard ADEL line supports and ADELITE synthetic rubber—all except the droopy pants! ADEL line supports are produced under U. S. Patents No. 2,215,283; 2,227,528; 2,279,865; 2,279,866; 2,228,158; 2,291,887; 2,310,622. Other U. S. and foreign patents pending.*

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421 Mutual Home Building, DAYTON, OHIO • 1444 Washington, HUNTINGTON, W. VA. • 303 Wareham Building, HAGERSTOWN, MD. • 302 Bay Street, TORONTO, ONTARIO

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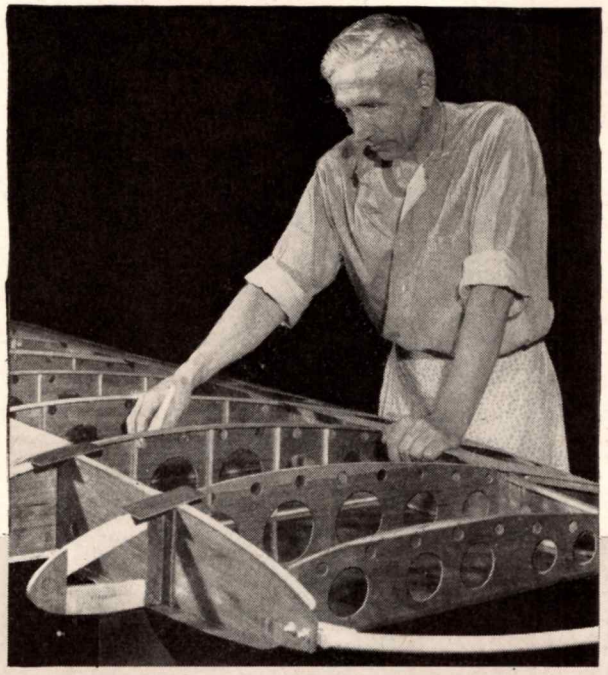


For Nearly **100 Years**

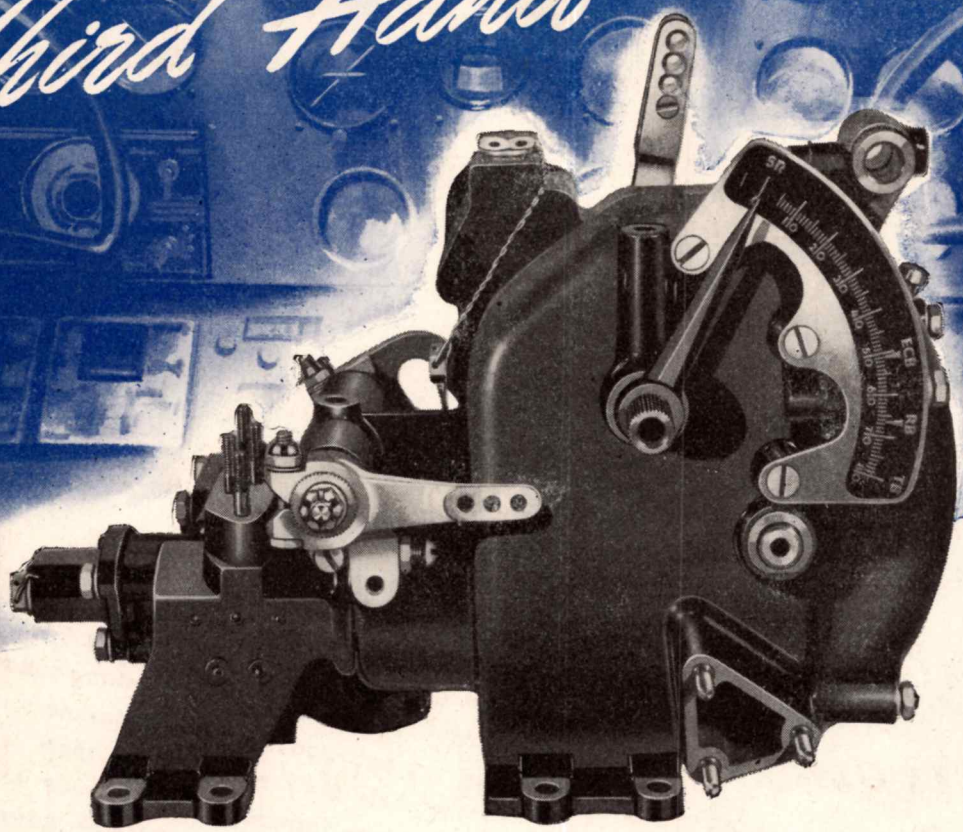
Grand Rapids Craftsmen have won world fame for their fine furniture. They are the greatest reservoir of skilled woodworking production in America; whose experience and facilities are now concentrating on aircraft.

3,000,000 feet of productive floor space; hundreds of fast, modern woodworking machines; thousands of skilled craftsmen; the facilities and resources of 15 plants; experienced engineering and research — all are behind the capacity of GRAND RAPIDS INDUSTRIES to quickly produce in volume for AIRCRAFT or other war production in wood — solid or laminated.

GRAND RAPIDS
INDUSTRIES, INC.
GRAND RAPIDS, MICHIGAN

15 Plants
Famous for Fine Furniture
United in War Production
for the Aircraft Industry

A *Third Hand* FOR THE PILOT



Simmonds-Hobson Automatic Engine Controls For Greater Efficiency and Engine Protection

COMBAT calls for split-second action. In the heat of battle at constantly changing speeds and altitudes, the warplane pilot has little time for careful adjustment of his engine controls. Modern engines can "take it," but at a sacrifice of their service life.

A welcome engineering advance toward more freedom for the pilot, and safer, more efficient engine operation, is the Simmonds-Hobson Automatic Engine Control—a "third hand" for the pilot. Units now in production for the United Nations' fighting aircraft provide automatic control of manifold pressure and mixture, maintaining a selected setting through varied maneuvers and altitudes. More advanced designs now under way will extend automatic control to propeller governor, spark, and other functions.

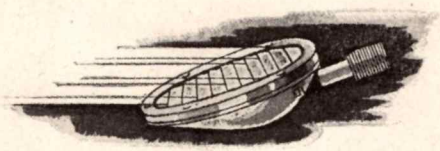
"Simmonds Equipment Flies With Every Type of Allied Aircraft"

- ★Automatic Engine Controls
- ★Push-Pull Controls
- ★Hydraulic Accumulators
- ★Equipment and Components for Hydraulic Systems
- ★Chronometric Radiosondes
- ★Spark Plugs
- ★Cowling and Panel Clips and Fasteners
- ★Self-Aligning Rod-End Bearings

SIMMONDS AEROCESSORIES INC.

10 ROCKEFELLER PLAZA, NEW YORK, N. Y. 6253 HOLLYWOOD BOULEVARD, HOLLYWOOD, CALIFORNIA

Follow the Leader!



That was a great game when we were kids, but it's a Life-or-Death matter for the men of our bombing squadrons. When they set out, under cover of darkness, to rain blows on the Axis they must follow their lead plane and maintain close formation. Their guide is the "Grimes Formation Light," which provides an easy-to-follow directional beam.

Grimes B-2270 (AN-3030) Formation light is a flush-type fixture mounted toward the trailing edge of the wing. Its special prismatic lens bends and directs the light rays toward the eyes of the following pilots in formation.

This light is another example of Grimes leadership in design and manufacture of aircraft lighting equipment. This leadership is proved by the quality and performance of more than 100 different Grimes Lights.

GRIMES MANUFACTURING CO. . . . . URBANA, OHIO

If it's Aircraft Lighting..

GRIMES

ARMY E NAVY

Designs and Make[illegible]!

NICE AND FAST

in fact

FASTER THAN SOUND*

An officer of the U. S. Army Air Forces has dived a Republic Thunderbolt beyond the 780 M.P.H.* mark, exceeding the speed of sound.

This unparalleled feat resulted in high praise for pilot, plane and parts — not the least important of which were the NICE precision aircraft bearings in the controls system.

This same dependable ball bearing performance is available to you NOW and for Post War applications. Let us tell you more about it.

Manufacturers of Precision and Commercial Ball Bearings

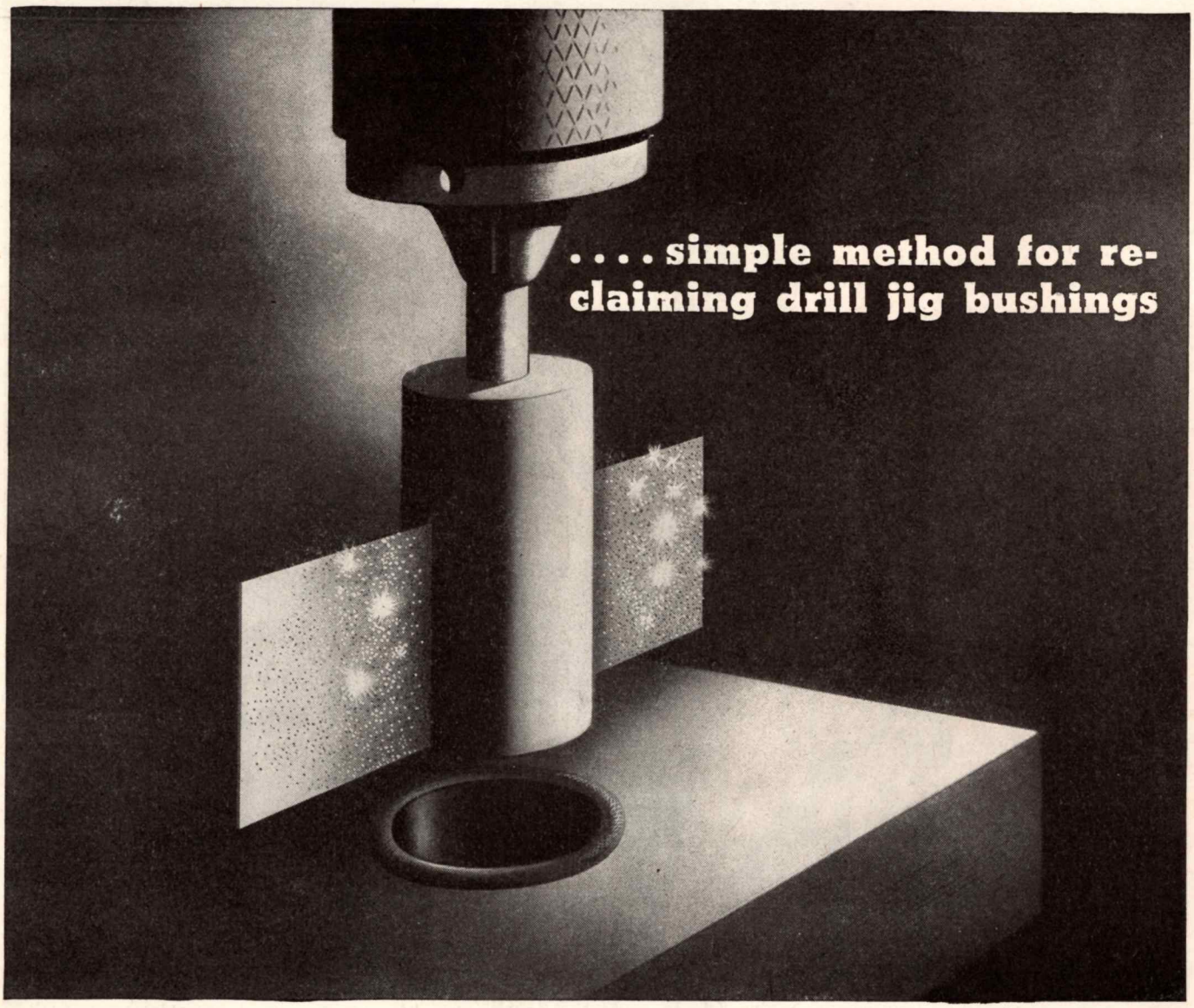
NICE

Aircraft Bearings

NICE

NICE BALL BEARING CO.

NICETOWN PHILADELPHIA PENNSYLVANIA



Information furnished by an Industrial Publication

The interior surface of drill jig bushings can be injured in several ways: by galling, burning, or seizing of the drill. In one manufacturing plant a simple but very effective method has been developed for restoring the surface by honing.

The equipment consists of a mandrel and a piece of abrasive cloth. The mandrel can be made from scrap rounds or cut-offs. The body is turned down to a diameter slightly less than that of the bushing, and the shank machined to fit into a conventional drill chuck.

The body is slotted at the bottom to take a piece of abrasive cloth somewhat wider than the depth of the bushing. The cloth is wrapped around the mandrel and the assembly started in the hole before power is applied.

If a coolant or oil lubricant is used, the bushing can be "honed" by moving the mandrel up and down as it rotates. As the hole enlarges, or as the "gall" is removed, additional pieces of abrasive cloth can be caught under the original piece to enlarge the hole still further.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

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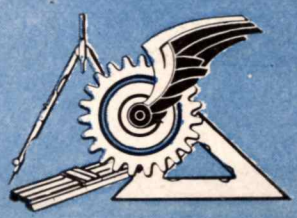

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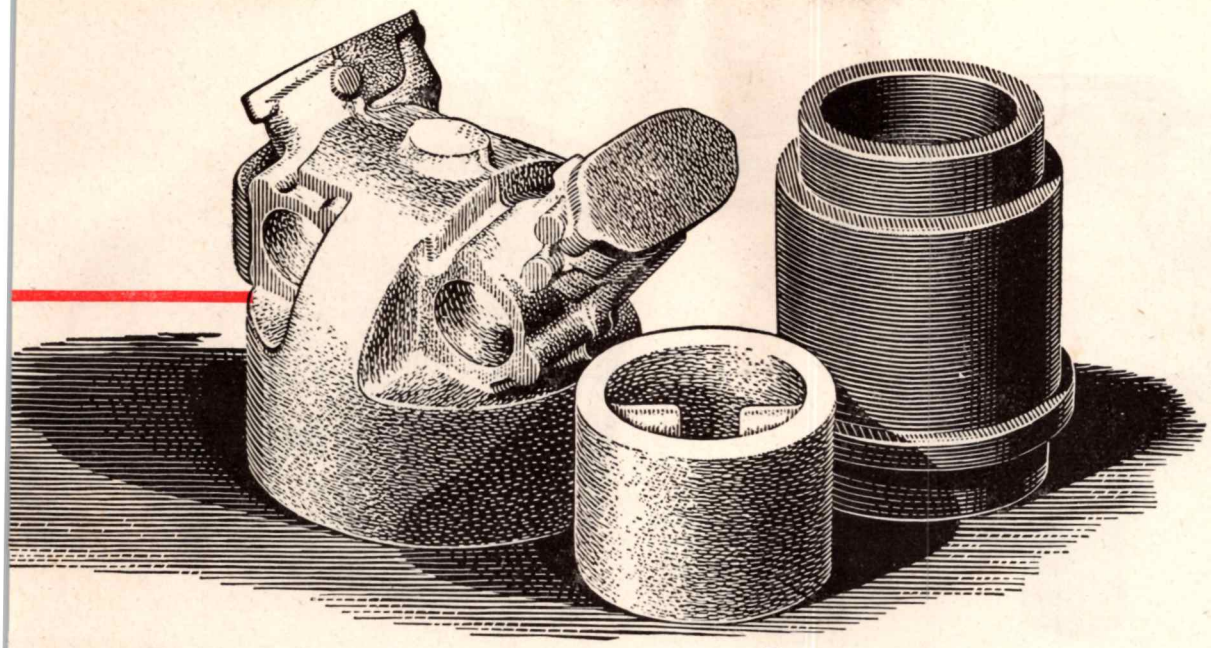
Precision heat treating of



Aluminum Alloy and Steel

AIRCRAFT FORGINGS

Precision heat treating is the *Siamese twin* of expert forging. Both are indispensable in Tube Turns' large scale production of aluminum cylinder head, aluminum piston and steel barrel *forgings* (shown above).

These are no ordinary forgings. Their end use is crucial. Their production must be flawless. *Accurate heat treating* is especially imperative, because allowable variations from specified hardness are extremely small in these vital parts. At Tube Turns, we maintain exceptional production and laboratory controls over *every* heat treating step to assure the best possible grain structure. And we do it in step with pressing, around-the-clock production schedules.

Tube Turns has earned a unique reputation for turning out difficult aluminum and steel forgings with seemingly impossible precision and promptness. We shall welcome inquiries from forward-thinking engineers and manufacturers who need forgings, or forging ideas, now or in the future.

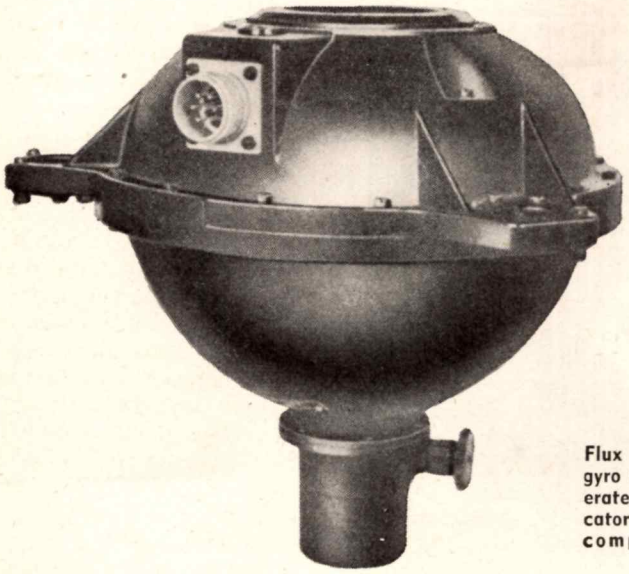
TUBE TURNS (Inc.) **LOUISVILLE, KENTUCKY**

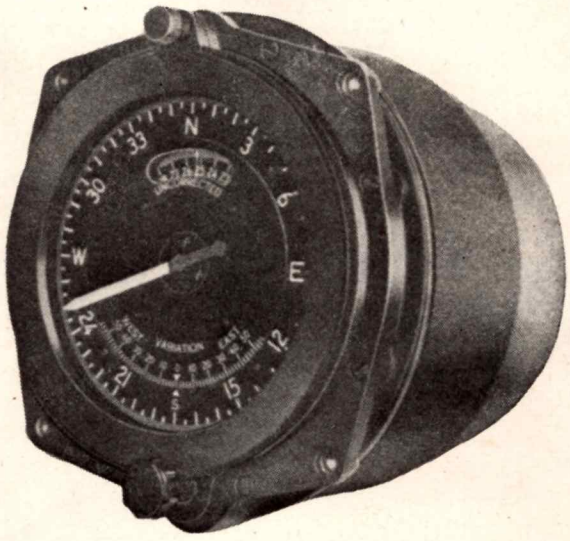
TUBE TURNS

Forgings for Industry

ARMY E NAVY

M





Flux gate unit with gyro (left), which operates master indicator (right) to give compass reading

THE PIONEER FLUX GATE COMPASS

THE first real improvement over the magnetic needle compass in almost 4500 yrs was the invention of the gyro compass, early in this century. This provided a meridian-seeking, shipboard compass, unaffected by rolling, turns, or magnetic variations. Adapted to aerial navigation, the gyro compass had its limitations, for it required initial setting from a magnetic compass, and frequent resetting in flight, particularly in rough air, and after turns. The new Pioneer Gyro Flux Gate Compass System, as it is called, details of which have just been announced, was developed to fill the need for a fast acting, undisturbed accurate azimuth indication in flight. The new compass will not lag or overshoot during a turn, it will not go off its reading in dives or rapid climbs, nor will it oscillate or "hunt" back and forth in rough weather.

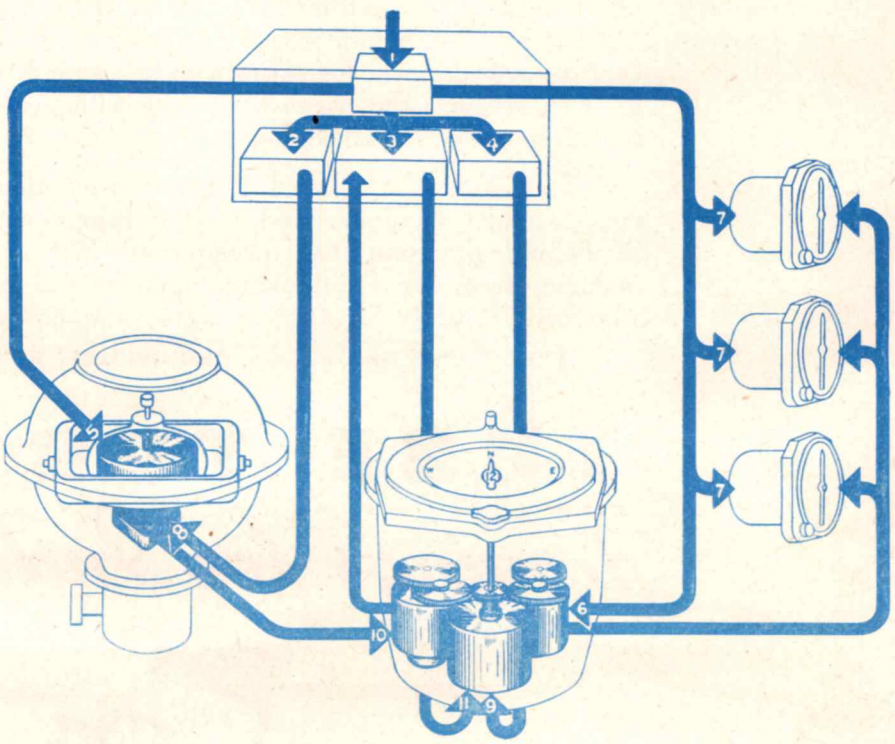
It provides an accurate indication of the magnetic heading of an aircraft under virtually all possible flight conditions, according to the manufacturer.

Operates Within 3° of North

Furthermore, the flux gate is operable within three degrees of the North pole (180 miles), while a magnetic compass is useless within 20° of the North pole (1200 miles), it is said. Developed primarily for aircraft, it has also been adopted for use on PT boats, for the card of the conventional magnetic compass fluctuates violently on vessels maneuvering rapidly at high speed. Credit for this compass goes to the Bendix Aviation Corp., Eclipse-Pioneer Div.

This new system is a remote indicating earth induction compass and consists of four main parts; (1) the flux

Schematic drawing of compass system with power source (top), sensitive flux gate transmitter, and gyro (left), master indicator which is located in the navigator's compartment (bottom) and remote indicating repeaters (right)



gate which is also a transmitter; (2) an electrically driven horizon gyro; (3) an amplifier; and (4) a master indicator or master compass with dial which is located at the navigator's station. Remote indicating repeaters with dials duplicate the readings of this master indicator and are located at various stations within the airplane. A fifth unit, the remote caging control, is used to bring a tumbled gyro quickly to the vertical. Provision has been incorporated for compensating the compass, for deviation, so that a fully corrected magnetic heading is always indicated by the master indicator.

To provide reliable compass indications on aircraft equipped with armament, armor-plate and bombs, the system has been made remote indicating which permits mounting of the magnetic azimuth sensitive element, the flux gate unit, at a point remote from electro-magnetic disturbances. The accuracy of the indications is achieved by the use of an adjustable cam-type compensator within the master indicator. No compass correction card is required at the master indicator. Also the master indicator has a dial reading adjustment, whereby the navigator may introduce into the system, correction for the value of magnetic variation, thereby obtaining a reading of true heating which is fully corrected and which requires no interpolation.

The flux gate unit which picks up the directive force of the earth's magnetic field, consists of three coils forming the three equal sides of a triangle, about 1½-in long. Each coil consists of a core with an exciting winding and a pick-up winding. When the exciting winding is energized from the aircraft generator, the flux intensity of the earth's field causes an induced current to pass through a cycle from max to min during each half cycle of the exciting current. A pulsating current in the pick-up coils results, the frequency of which is twice that of the exciting current, and the amplitude of which is exactly proportional to the amount of the earth's flux passing through that particular arm of the flux gate. Three signal voltages are thus obtained from the three pick-up coils of the flux gate which, in general, are of three different magnitudes. The pick-up coils are connected to the stator terminals of a coupling autosyn contained in the master indicator.

Operation of Master Indicator

Passing over the gyro whose sole function is to stabilize the flux gate in the horizontal plane, we come to the master indicator. In addition to the coupling autosyn already mentioned, the master indicator contains a transmitting magnesyn, a two-phase induction motor and a gear train which drives the indicator pointer; also the compensating mechanism for correction of deviation. Correction for deviation is applied by means of adjustment screws around the periphery of the dial.

The pointer shaft of the master indicator is geared to the induction motor which in turn is geared to the autosyn unit. The position of the master indicator pointer is relayed to the magnesyn repeater indicators in various parts of the airplane, by the transmitting magnesyn unit. The amplifier is a 5-vacuum tube unit two of which boost the induced rotor voltages of the coupling autosyn sufficiently to drive the induction motor.

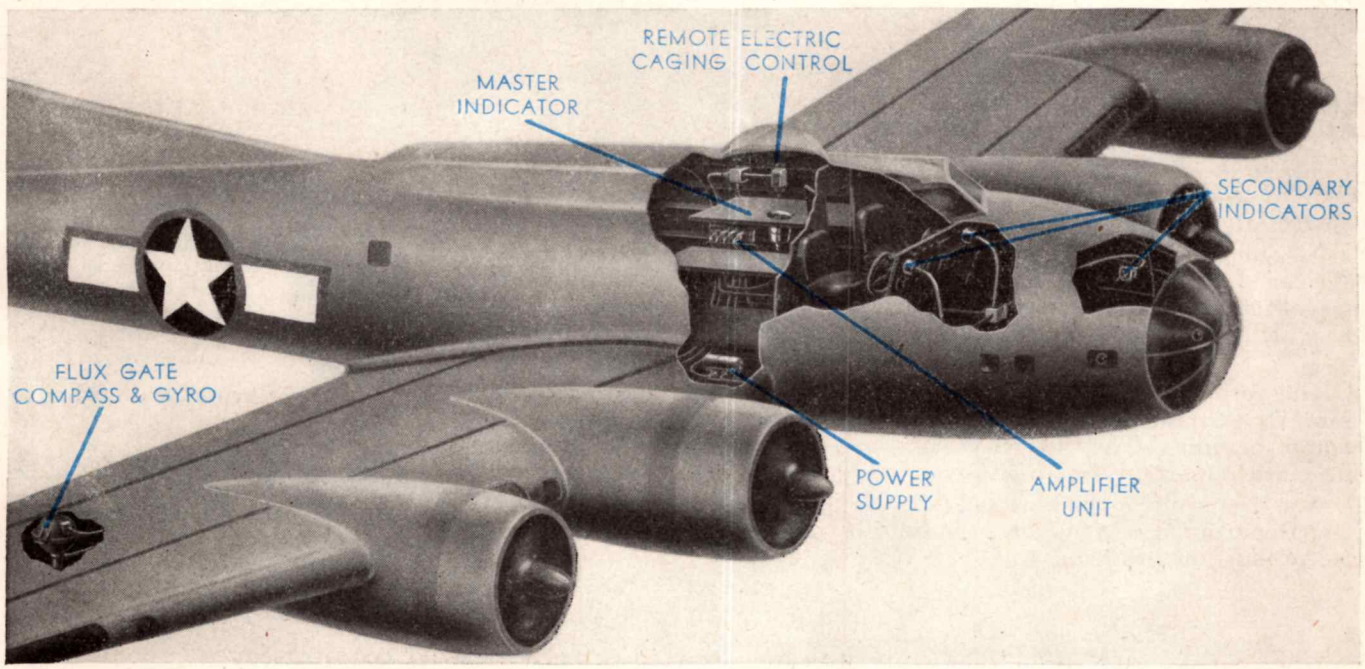
The magnesyn units operate in pairs, like the autosyn motors, to exactly duplicate at remote stations, dial readings at some central control station. One is a transmitter, the other an indicator. They were developed by Bendix to save weight. Each repeater indicator consists of a magnesyn unit, a graduated dial, a pointer, and a course setting marker. The magnesyn unit contains a 2-pole permanent magnet rotor within a 3-phase, 2-pole, delta-connected stator. The rotor carries the indicating pointer and is free to rotate in either direction—there being no stops or springs of any kind.

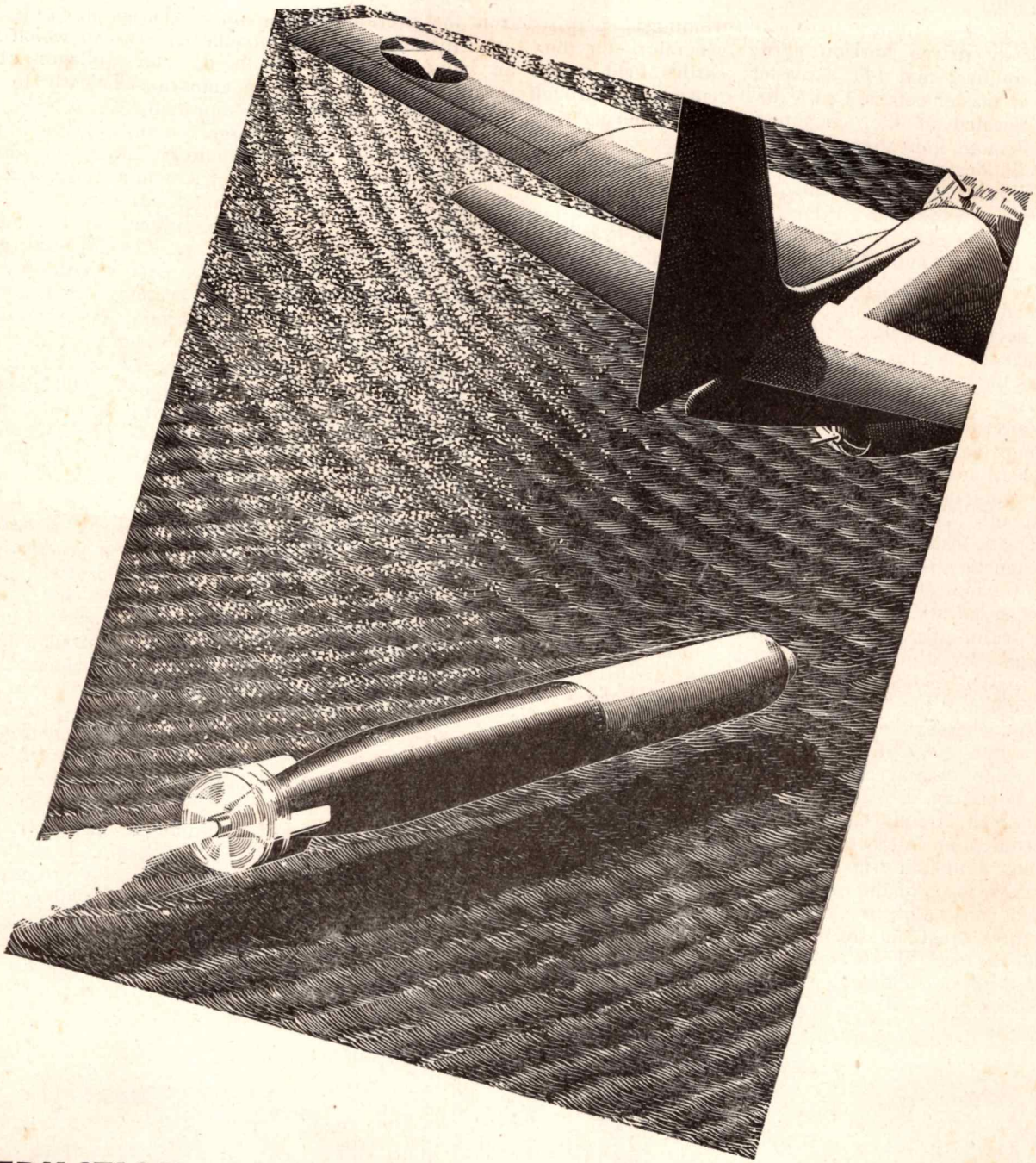
However, as in the autosyn, which was also developed by Bendix, the rotors neither spin nor produce power. Instead, the electrical design of the magnesyn is such that the rotors of two connected magnesyns, come into coincidence when energized, and thereafter the rotor of one magnesyn moves only the distance necessary to match any movement—no matter how slight—of the rotor of a second magnesyn.

When an airplane equipped with the flux gate system, starts out on a flight, the flux gate is energized by an exciting current from the aircraft central power supply. The pick-up coils on the three arms of the flux gate produce three signal voltages, the relative value of which is a function of the azimuth relation of the flux gate to the earth's directive magnetic force. Conducted

(*Continued on page* 157)

Flux gate compass system as installed with sensitive unit located in wing





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AMONG ALL the missiles man has contrived to hurl death at his enemies, the torpedo is unique.

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The torpedo is one more illustration of the fact that there is no more vital factor in the mechanized war we fight today than anti-friction bearings. They literally *make possible* the *sustained* action of our more important tools of war.

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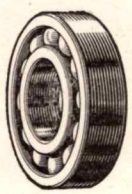

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New Departure

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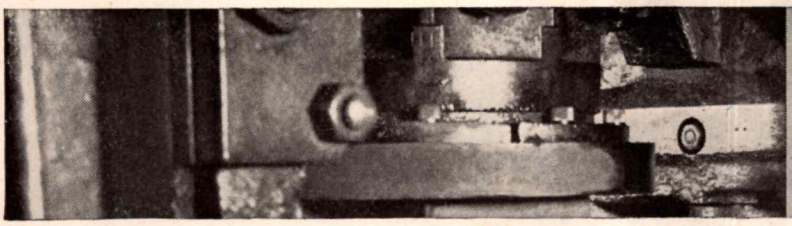
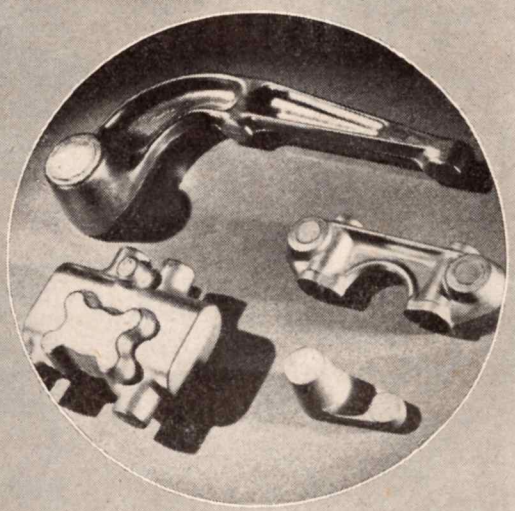


A DOW MAGNESIUM SERVICE — FORGINGS



Dowmetal Magnesium alloy forgings for aircraft produced in hydraulic press forging equipment.

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The production of Dowmetal Magnesium Alloy press forgings is included in Dow's over-all magnesium service. Full cooperation, backed by complete facilities and intimate knowledge, is available to manufacturers engaged in war work or who are contemplating peacetime projects.

Magnesium forgings possess a desirable combination of strength, light weight and pressure tightness. A complete line of both mechanical and hydraulic presses makes available magnesium forgings in a wide range of sizes.

Because of long experience in the production of magnesium and its fabrication in all forms, Dow is the recognized source of information on this weight-saving metal. If you are dealing with magnesium, consult Dow.

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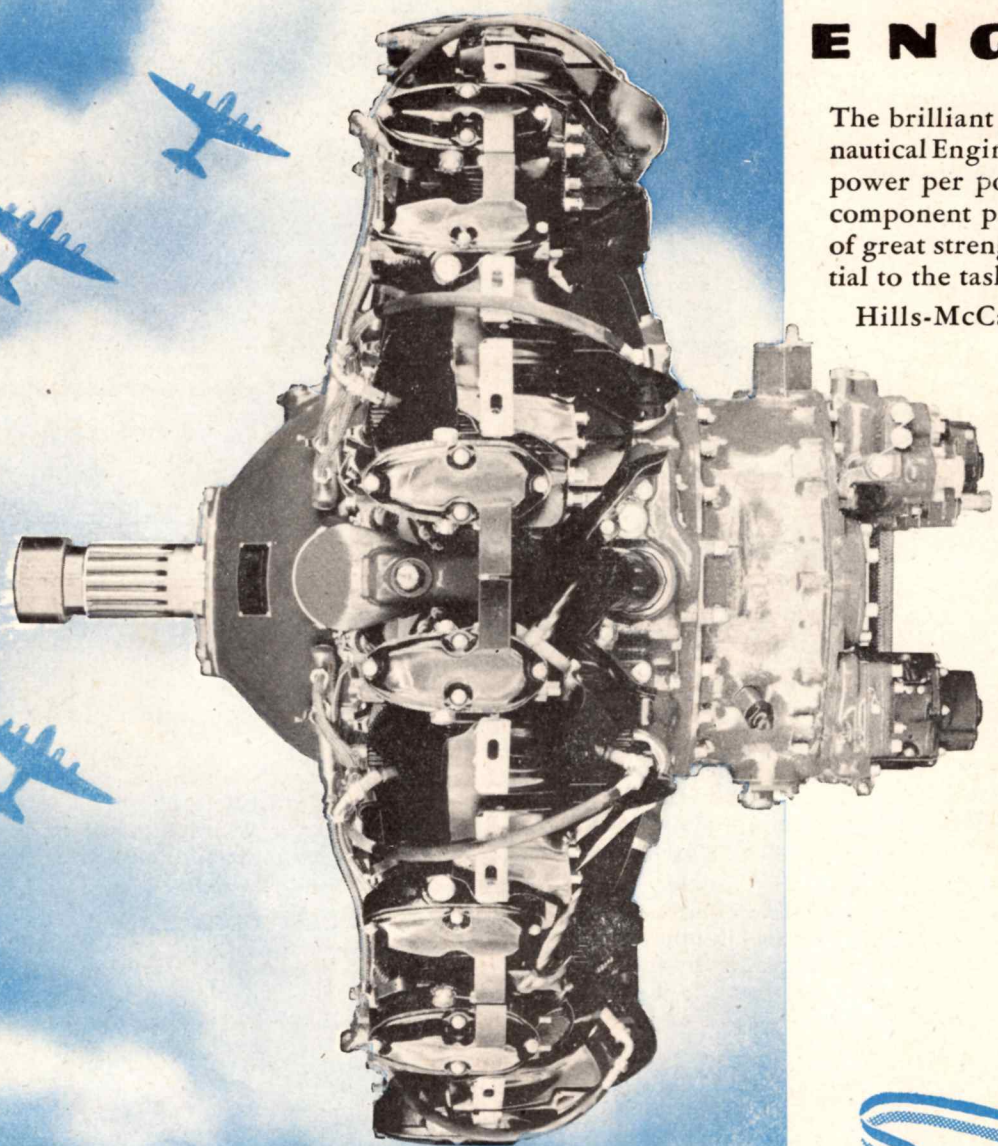
Wright ENGINES



The brilliant Wright "Cyclone" Aeronautical Engine, designed for maximum power per pound of weight, requires component parts necessarily light, yet of great strength and endurance essential to the task.

Hills-McCanna Magnesium Alloy Sand Castings contribute this rare combination of qualities to the efficiency of Wright Engines through highly advantageous application.

Our expert engineers, fortified with years of intensive experience with these castings can be of valuable assistance to you in your consideration of post-war plans and products.

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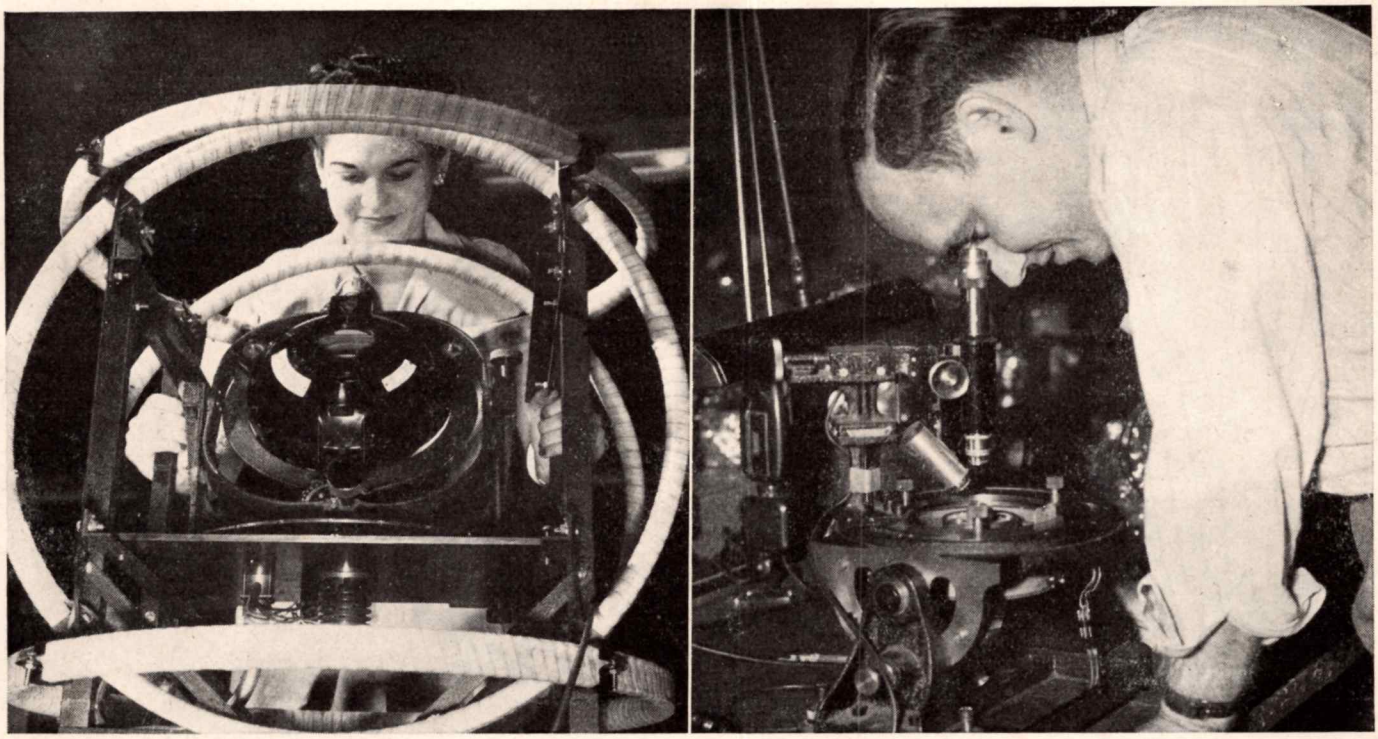


Left: Testing flux gate unit in its gyro setting and inspecting intricate parts with (right) high-power microscope

FLUX GATE COMPASS

(*Continued from page* 153)

to the three stator terminals of the autosyn, these signal currents produce an alternating magnetic field within the unit, inducing in the autosyn rotor an alternating current—unless the rotor is at the null position. The induced voltage is amplified sufficiently to excite one phase of the 2-phase induction motor, and when both phases are energized, the motor rotates the autosyn through the gear train and the rotation continues until the autosyn rotor is in the null position, when the voltage drops to zero. (When the aircraft is headed straight on its course, the various functioning units are in the null position). When the angular relation of the flux gate to the earth's field is changed—as happens when the aircraft turns toward a new heading—the autosyn rotor is rotated by the induction motor through the same angle, and in the same direction.

Routing of Power Supply

A glance at the schematic drawing shows that power from the aircraft central supply enters the 400-cycle voltage adjuster (1). From here it goes directly to points (2); the amplifier (3); point (4); the gyro (5); the transmitter magnesyn (6); and to the magnesyn repeaters (7). Point (2) furnishes excitation power for the flux gate (8); and point (4) provides current for the fixed phase of the induction motor (9). The gyroscope is used solely to maintain the sensitive flux gate element in a horizontal plane, and thus obviates all errors ordinarily set up by the vertical component of the earth's field — a result of turns, banks, climbs, dives, yaws, and pitches. The gyro motor is a self-starting, four-pole, split-phase type of unit, and operates at approximately 10,000 rpm.

As the aircraft changes direction, the angular relation of the flux gate to the earth's magnetic field is altered and the voltage balance between the flux gate and the autosyn stator is disturbed—inducing a signal in the rotor of the autosyn (10). This current is passed on to the amplifier (3), where it is stepped up sufficiently to supply the control phase of the induction motor (11).

When the induction motor is thus energized, it develops a torque which drives, by means of a gear-train, the rotor of the autosyn. The autosyn, linked to the indicating system, as shown in the schematic drawing, simultaneously positions the pointer of the master indicator (12) and the rotor of the transmitting magnesyn (6). Displacement of this rotor shifts the field in the transmitting magnesyn, and produces a corresponding shift in the fields of the magnesyn repeaters (7). Consequently, the rotors of the repeater magnesyns alter their positions, and, since pointers are attached to the shafts of these rotors, all repeaters show the new heading.

The system operates on 400 cycles ac at 24v, 26v, 28v, 105v, 115v, or 125v, and draws a maximum of 45 watts. If the aircraft power supply does not provide one of these voltages at a controlled frequency of 400 cycles, an inverter will supply it from the 24v dc source.

Remarkable Production Job

The Bendix Aviation Co. is doing a remarkable war production job in its 15 factories, and in many lines, such as aircraft carburetors, landing gears, radio equipment, direction finders, engine starters, generators, 20-mm aircraft guns, aircraft electrical equipment, and allied products. Charged with the manufacture of a million dollars worth of aircraft instruments monthly, and given a year in which to do it, a handful of Bendix men took over an empty building at the end of 1940 and in seven months had tooled up and achieved the goal. This schedule was doubled in the next three months, and by the end of 1941, 40,000 precision instruments were being made every 30 days. Last month's production exceeded 175,000 such units!

The flux gate compass was conceived and developed by Bendix research engineers, notably A. A. Stuart, over a period of seven years, and then put into mass production. It has been used on many bombing and other missions in different parts of the world. While it is almost a certainty that one or more of these compasses have been captured, their operation is based on such radically new principles and their manufacture involves such remarkable precision, that it is doubtful if the enemy could produce them during this war, even if they had a full set of working drawings.

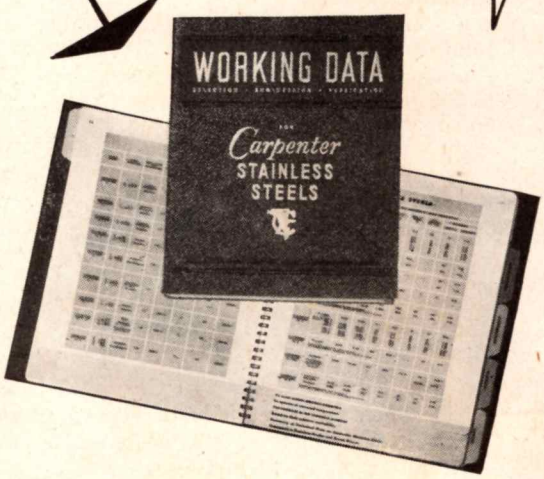
How to select STAINLESS STEEL to meet your requirements

In giving your old or new products the benefits and advantages of Stainless Steel, it is necessary to decide what physical properties, corrosion resistance, and fabricating qualities are needed to meet your specific job requirements.

The popular 18-8 Stainless Steels provide exceptional physical properties, maximum corrosion resistance and excellent fabricating characteristics. There are many applications where these Stainless types can be used to give products longer life and greater utility on the job. To get the most out of 18-8 Stainless, it will pay you to consult Carpenter, who pioneered the development of Stainless Steels, and who, for years, has been helping to solve the problems of Stainless users.

For complete information on all types of Stainless available from Carpenter, write us for a copy of the helpful 98-page book, "Working Data for Carpenter Stainless Steels". This book simplifies the selection, engineering and fabrication of Stainless Steels. It is free to Stainless users in the U. S. A. Just drop us a line on your company letterhead.

Here are some examples of the helpful information Carpenter can give you on certain types of Stainless to meet specific conditions. These 18-8 types are non-magnetic and are hardenable only by cold working.

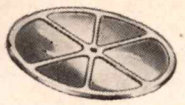


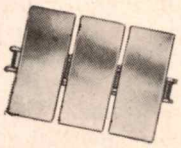
THE CARPENTER STEEL COMPANY • 116 W. BERN STREET • READING, PA.

more than corrosion resistance

For Greater Strength and Extra Corrosion Resistance in Stainless Parts

CARPENTER STAINLESS NO. 4—TYPE 302



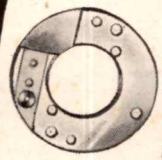


This popular 18-8 type is extremely tough and ductile, and is used in many parts such as stampings, conveyor chains, springs and many cold headed products. Carpenter Stainless No. 4 finds wide application in the form of strip and wire for cold heading purposes. It resists corrosion from all foodstuffs, sterilizing solutions, most of the organic chemicals and dyestuffs, and a wide variety of inorganic chemicals.

Fabricating Qualities: No. 4 responds easily to forging, deep drawing, bending, forming and upsetting both hot and cold. If formed hot or welded, a corrective anneal is required after fabrication to secure the best corrosion resistance. If a corrective anneal after welding or forging is impossible, use Carpenter Stainless 4-Ti or 4-Cb. The satin-smooth ABC finish on No. 4 strip often makes polishing unnecessary. As this Stainless is difficult to machine, parts that require considerable machining should be made from Carpenter (Free-Machining) Stainless No. 8.

Faster Output—Fewer Rejects of Machined Parts

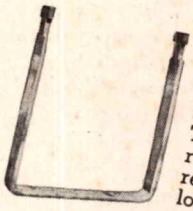
CARPENTER STAINLESS NO. 8—TYPE 303



This Stainless is a Free-Machining 18-8 chrome-nickel steel, used for automatic screw machine parts, valve parts, aircraft engine parts, etc. From the standpoint of corrosion and scale resistance, Carpenter Stainless No. 8 may be used interchangeably with Carpenter Stainless No. 4. This Stainless can be readily forged, machines about like SAE 3120, 4615, etc., and is easy to grind or polish. For deep drawn or cold headed parts, Carpenter Stainless No. 4 is recommended.

Physical Properties Comparable to Carpenter Stainless No. 4.

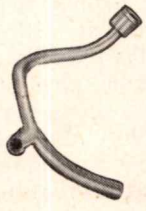
To Meet Severe Corrosion Requirements



Carpenter Stainless No. 4-Mo (Type 316) is used in pickling racks, circulating pumps, to combat many chemicals, such as sulphurous acid compounds employed in the process industries. Those chemicals which are partially resisted by No. 4 are usually better resisted by No. 4-Mo. It is therefore the logical metal to try where No. 4 is good—but not good enough.

See Physical Properties for Carpenter Stainless No. 4.

For Heat Resistance and Specific Welding Qualities



Carpenter Stainless No. 4-Ti (Type 321) and No. 4-Cb (Type 347), were developed for one and the same purpose . . . to strengthen the 18-8 chrome-nickel steels against damage when used within the "danger zone"—800°F. to 1400°F. These grades are especially applicable to aircraft exhaust manifolds and forged or welded parts that cannot be given a subsequent anneal.

See Physical Properties for Carpenter Stainless No. 4.

Physical Properties of Carpenter Stainless No. 4

YPE 302—(CARBON .10%—CHROMIUM 18.00%—NICKEL 8.00%)

Tensile Strength—85,000 to 225,000 lbs. per sq. in.

Specific gravity—7.93.

Melting point—Approximately 2550°F.

Specific Heat—.12.

Thermal Conductivity—.052 C.G.S. units at room temperature.

Coefficient thermal expansion—.0000095 average 68°F. to 1500°F. (this is about 50% higher than mild steel or the simple chromium Stainless Steels).

Specific electrical resistance—417 ohms per cir. mil foot at 68°F. Temperature coefficient—.000425 per deg. F. between 68°F. and 1500°F.

Magnetic properties—Nonmagnetic unless work-hardened, when it becomes slightly magnetic.

Permeability—As annealed =1.003 max.

Elastic modulus—29,000,000.

NOTE: The physical properties of all grades of Stainless Steel depend upon form, heat treatment or cold working. Wider ranges of properties are available in certain forms. Take up your special problems with our representative.

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DR. MAX M. MUNK

Lecturer in Aerodynamics, Catholic University of America

● Airplane drag research means airplane performance research. Were it not for the direct effect of the drag on the performance, the precise magnitude of the drag would not be of much interest. But even a small saving in drag leads to a distinct improvement of the performance. The drag research remains therefore active and intense. And as we learn more and more about the drag, we become better and better prepared to compute the airplane performance.

It was so from the very beginning. It was early understood that an airplane flying at various angles of incidence does not experience a drag proportional to the square of the velocity, but that the relation was more involved. The true relation remained unknown for a number of years until at last this writer computed and plotted the first induced drag parabola. A summary performance computation method based on a mathematically simple law containing a few parameters was thus established. The graphical point-by-point method, employing empirical test results and analysing them for a number of incidence angles or flight velocities was put into the background. Instead, the parasite drag, proportional to the dynamic pressure, was complemented by the induced drag, inverse to the dynamic pressure, and the resulting simple equation was used directly.

The Basic Drag Equation

Two drag terms, respectively proportional to and inverse to the dynamic pressure, lead immediately to the following basic drag equation in keeping with the induced drag theory:

$$(1)\quad D = p^2\, V^2\, \rho/2 + \frac{W^2}{s^2\, V^2\, \rho/2}$$

where D denotes the drag, $V^2\ \rho/2$ the dynamic pressure, W the total airplane weight, and p and s two lengths to be discussed immediately.

The inspection of any polar diagram of an airplane suggests forcibly, and leads early to the recognition, that the two right hand terms of Equ. (1) are very suitable for correcting each other. The parasite drag at various angles of incidence is not truly proportional to the dynamic pressure, but is so only dominantly and in first approximation. An additional term inverse to the dynamic pressure complements the parasite term most happily in bringing about a closer agreement with the facts.

Also, the induced drag is not truly inverse to the dynamic pressure, but is so only in large part and in first approximation. An additional term proportional to the dynamic pressure complements the induced drag term most happily in bringing about closer agreement with the facts. The two lengths p and s are not determined by pedantic physical considerations, but are chosen to make Equ. (1) as true as possible. The first term, $p^2\ V^2\ \rho/2$ is merely a nominal parasite drag, dominated by but not identical with the actual parasite drag, and comprehends also a minor portion of the induced drag. The second term, $W^2/\ (s^2\ V^2\ \rho/2)$, is merely a nominal induced drag, dominated by but not identical with the actual induced drag, and comprehends also a minor portion of the parasite drag. The length p, the nominal parasite length, is not equal to the true parasite length, the square side of the parasite drag area, but is slightly larger. The length s, the nominal span length, is not equal to the true span length, the effective span multiplied by $\sqrt{\pi}$, but is slightly smaller. It is generally larger than the effective span but smaller than its product by $\sqrt{\pi}$.

Equ. (1) is dependent on the two drag variation laws. The drag increases beyond what the square law would indicate when the angle of stall of the wings is reached. The angle of stall limits therefore the applicability of the basic drag equation. Since the minimum or landing speed is determined from the stalling limit, it is not taken care of and cannot be determined from the equation.

Equ. (1) has only mathematically simple terms, just three in all, occurring in simple combination. This simplicity is its principal virtue and the root of its strength and value. The equation was adopted immediately after its discovery and is now universally used. It has never been modified or improved upon. Any modification would indeed impair its simplicity, and probably defeat its purpose.

The Basic Power Equation

Since the thrust power available is less variable than the drag, the basic equation (1) is generally written in terms of the power P when used for the performance computation:

$$(2)\quad P = p^2\, V^3\, \rho/2 + \frac{W^2}{s^2\, V\, \rho/2}$$

The pregnant briefness of this equation leads immediately to simple conclusions.

Equ. (2) combines six quantities into three terms. The equation is dimensionally correct, but dimensional considerations by themselves do not lead to it. The theory of dimensions would give admission to hundreds of additional terms actually absent. The statement of Equ. (1) and its corollary (2) required separate discoveries along the line of fluid dynamics.

Each of the three terms of Equ. (2) has its own engineering significance and is individually under the control of the designer. The first term, the power P, indicates what thrust power has been made available by the designer. The second term, containing the nominal parasite length p, indicates how well the designer has streamlined the airplane. The third term, containing the nominal span length s, indicates dominately how far the airplane wings extend in span and grip the air for support.

The three terms should also be compared with each other. Their three ratios, two of them independent ones, tell their own story. They are independent of and are obtained by the elimination of the magnitude and size of the airplane. In that respect they

(*Continued on page* 162)

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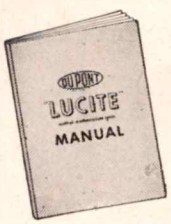

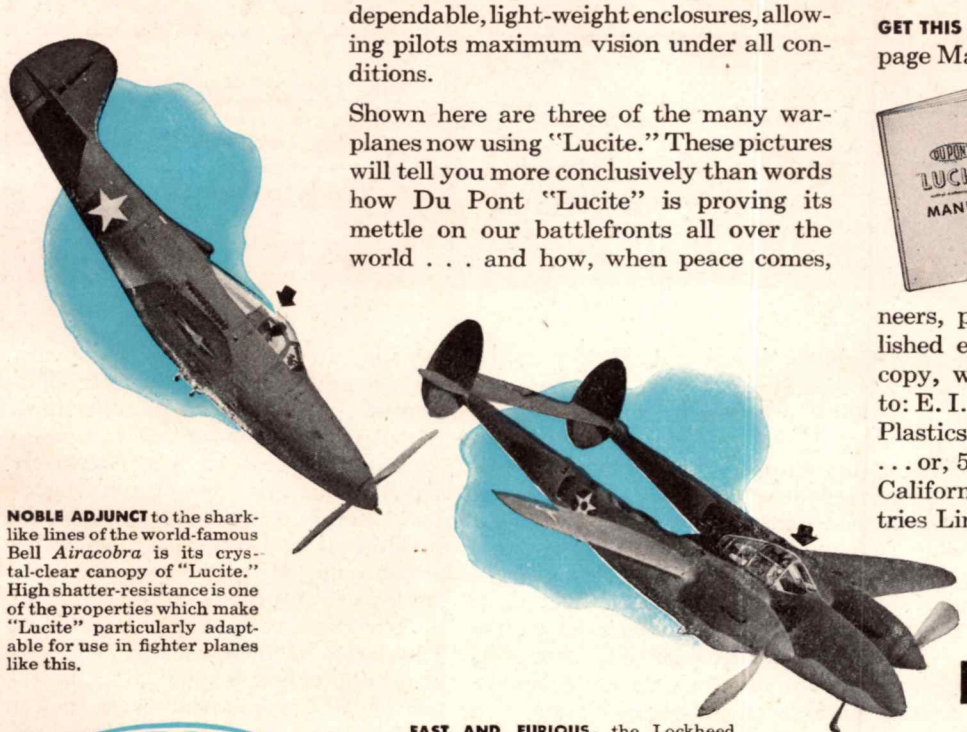

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BETTER THINGS FOR BETTER LIVING
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(*Continued from page* 160)

tell less than the original terms, but this less is more striking, illustrative and universal, particularly suitable for the comparison of airplanes of different size or weight.

The Cruising Flight

Progress in the interpretation of the basic equations (1) or (2) is made by separating the left hand side from the right hand side, and by studying first the right hand side by itself. What thrust power is available is at first disregarded. The aerodynamic features of the airplane are brought into vivid prominence by the contemplation of a particular flight condition which is not determined by the available power. The items of this flight condition are computed by means of Equ. (1) or (2).

Several flight conditions offer themselves for this service. One stands out as particularly suitable because of its technical significance and on account of the simplicity and harmony of the numerical relations ensuing. That is the flight of minimum drag. With truly constant power and specific fuel consumption, this is the flight of lowest fuel consumption per mile. It would thus entail the most economical cruising velocity. Accordingly this flight condition will be designated as cruising flight, and will be indicated by the subscript c.

Imposing the condition that the right hand side of Equ. (1) become a minimum leads to the following relations:

Cruising dynamic pressure:

$$(3)\quad (V^2\ \rho/2)_c = \frac{W}{p\ s}$$

Cruising velocity:

$$(4)\quad V_c = \sqrt{\frac{W}{p\ s\ \rho/2}}$$

Cruising drag lift ratio:

$$(5)\quad (D/L)_c = 2\ p/s$$

Cruising thrust power:

$$(6)\quad P_c = 2\ p/s\ W\ \sqrt{\frac{W}{p\ s\ \rho/2}}$$

At the cruising speed, the nominal induced drag is equal to the nominal parasite drag. Hence the two right hand terms of the equations (1) and (2) are then equal.

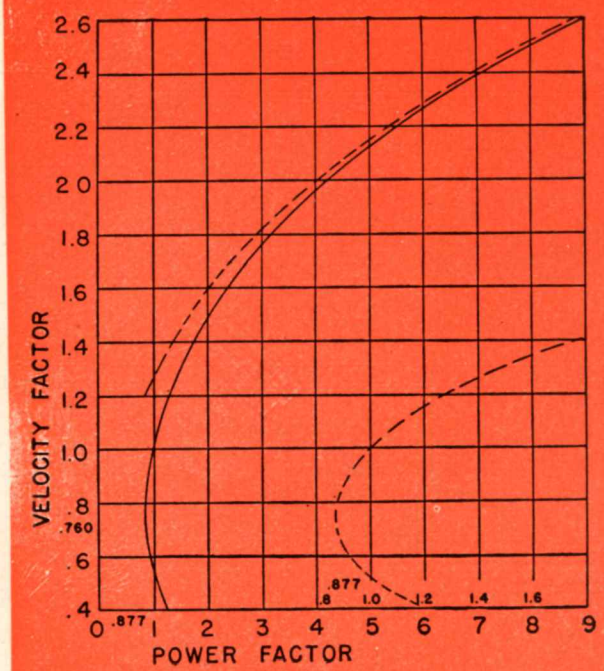
These different cruising flight items characterize the aerodynamics of the airplane as distinguished from its power supply. An airplane having a high cruising speed (4) is a high speed airplane. One calling for a high cruising power (6) is an airplane requiring broadly considerable power. A small cruising or minimum drag lift ratio (5) characterizes an aerodynamically clean airplane and has always done so. There was a period when the lift drag ratio was overplayed in connection with airfoil test results, and its use had to be curtailed in that connection. But the basic significance of the lift drag ratio of the entire airplane has never been doubted.

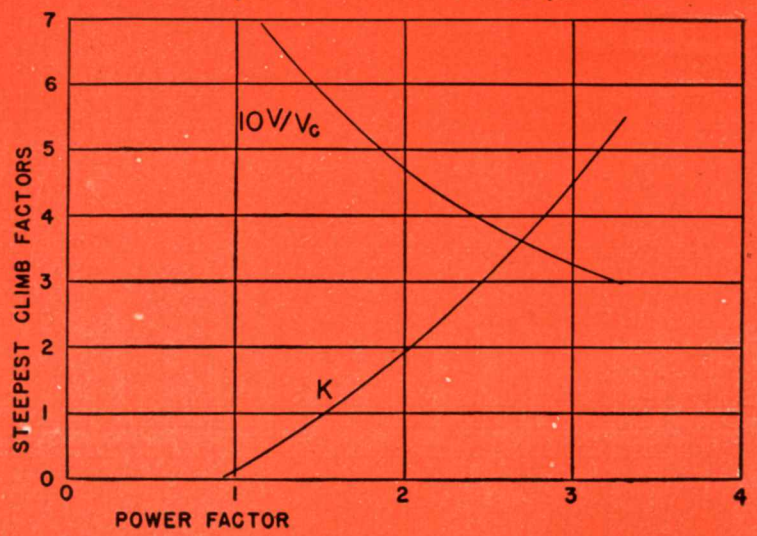
A clear rational procedure requires the use of one particular flight as a reference flight condition. The cruising flight is the preferable reference flight. The cruising velocity is the preferable reference velocity for all other flight velocities of which the airplane is capable. The ratio of any other flight velocity to the cruising velocity, the velocity factor V/V_C, indicates how fast the airplane flies comparatively, that is it reveals its aerodynamic characteristics. At the same speed, a transport may fly comparatively fast and a pursuit ship may fly comparatively slowly. Likewise, the power factor P/P_C, the ratio of the power consumed in level flight to the cruising thrust power required, at the same air density, gives a preferable measure for the comparative power consumption. The degree of the powering of the airplane is thus given by P_m/P_C, the ratio of the maximum thrust power available to the cruising power required at the same density.

Before pursuing this thought further, it is advisable to apply the method also to the climbing flight condition. That

(*Continued on page* 304)

The relation between the power factor and the velocity factor is universally the same for all airplanes as far as the basic equation is valid. Below: Relation between the velocity factor of steepest climb and max. available power factor





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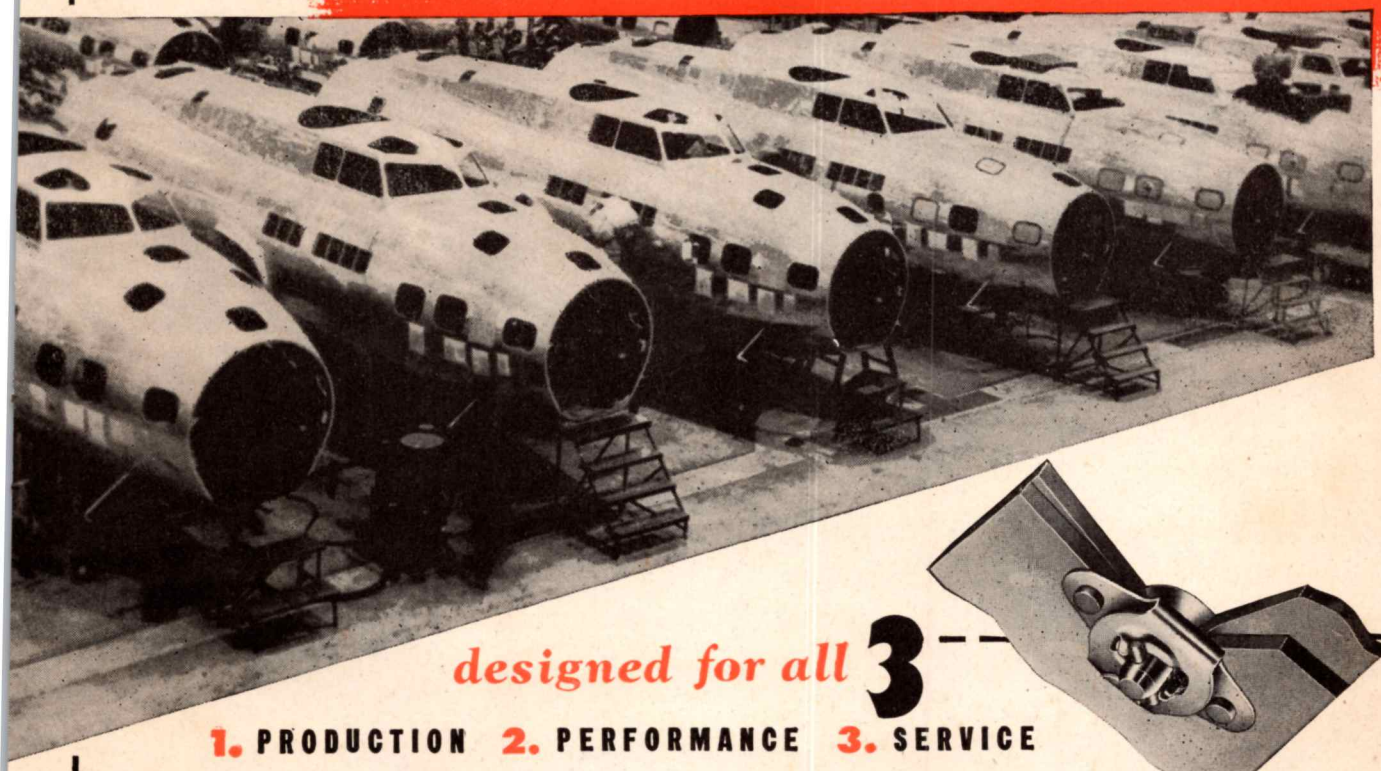

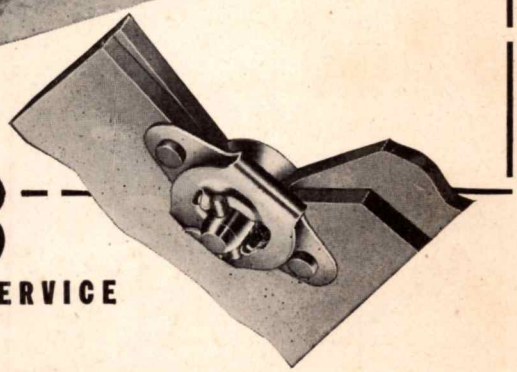

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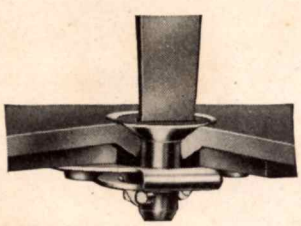

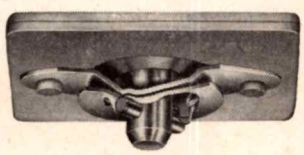

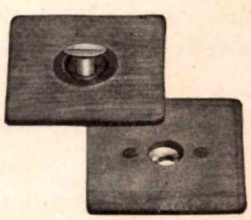

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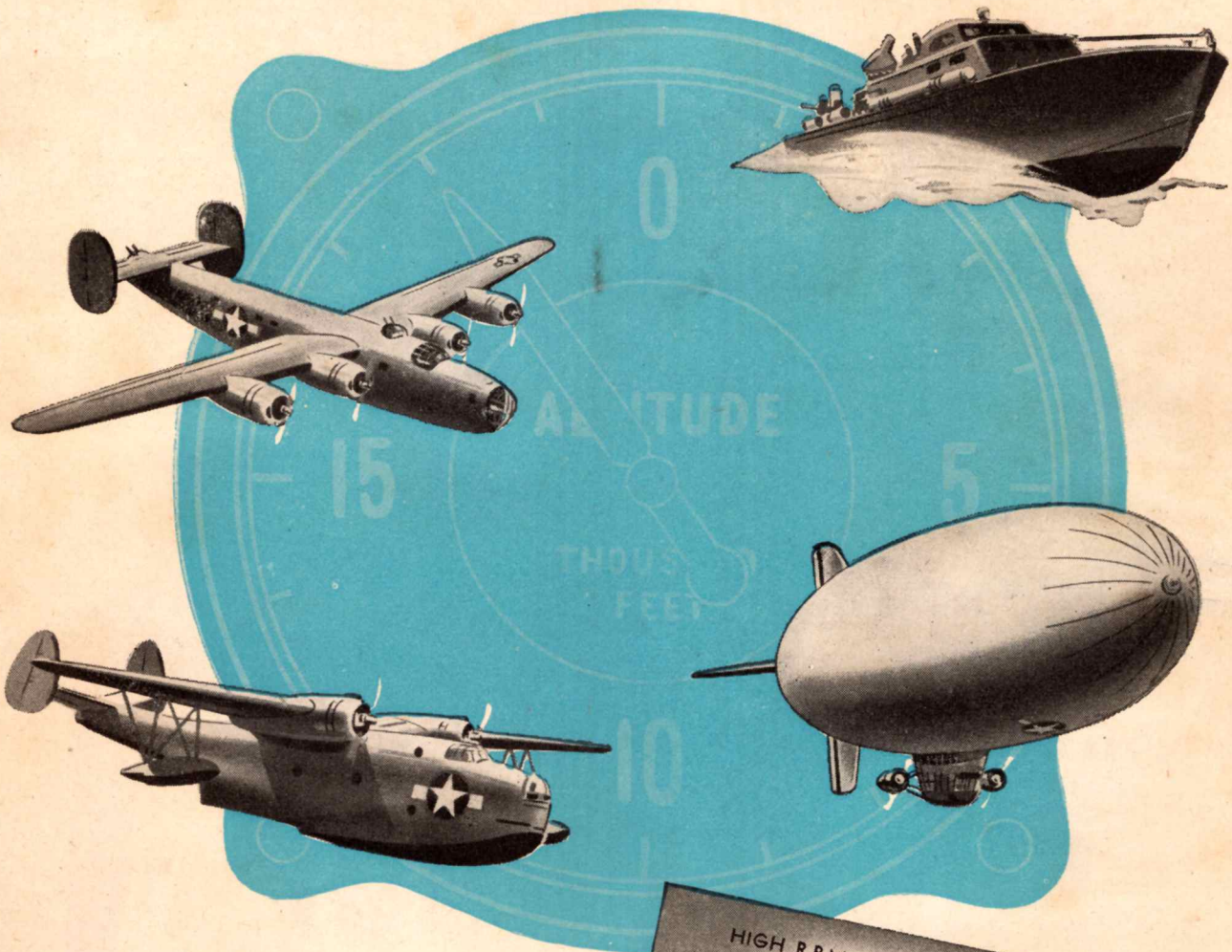

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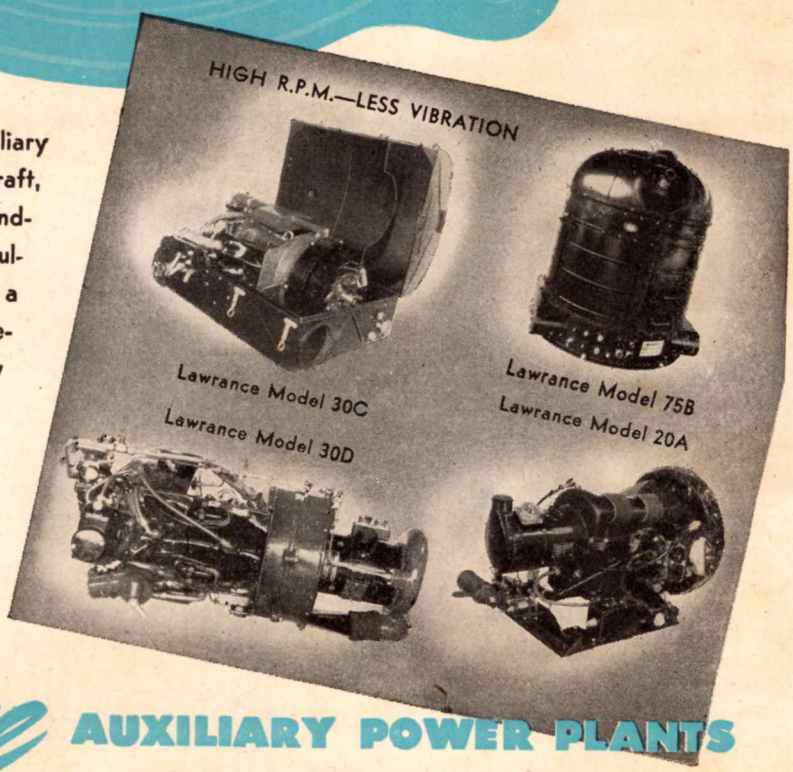

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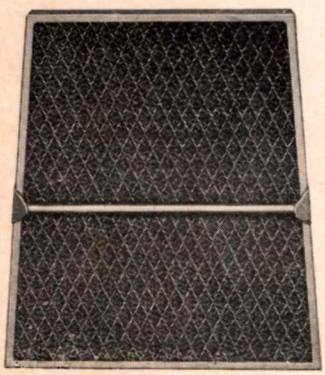
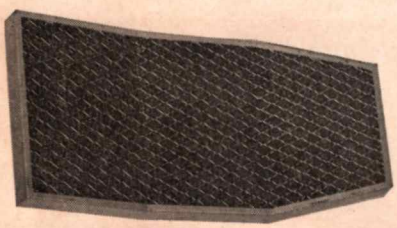


Typical AAF Airplane Engine Intake Filters as used on American bombers



AAF ENGINE INTAKE FILTERS MAKE DOUBLY SURE HIS STICK NEVER LETS HIM DOWN

Riding high in the clouds—alert to any enemy interceptor that might make a lucky hit on one of the precious fortresses he's assigned to protect—an American fighter pilot deserves to know that his ship will respond when he's forced to turn, twist and dodge to escape a withering enemy fire.

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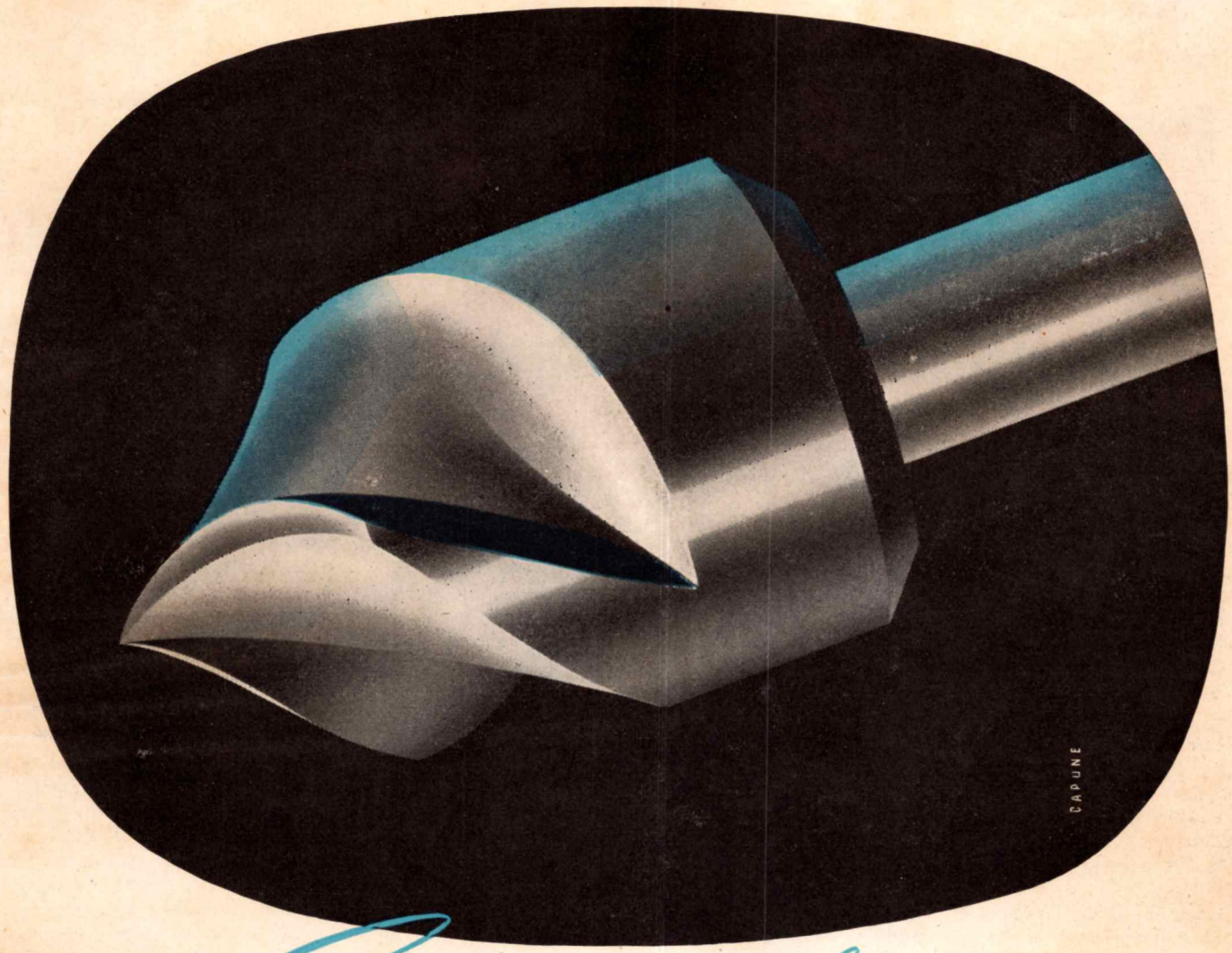

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LOS ANGELES CALIFORNIA

Production and Personnel Innovations at The Woodworth Plant

N. A Woodworth, president, N. A. Woodworth Co.

● Before the war, the N. A. Woodworth Co., Ferndale, Mich., was a small shop employing 25 people. Its business—machine tools—was chiefly a hobby for Newton A. Woodworth who had retired from the presidency of Ex-Cell-O Corp. a few years before. In 1940 the company produced some 400,000 units at a total sales price of $605,000.

Impending war changed Woodworth's plans. The company contracted with Wright Aeronautical Corp. for the delivery of aircraft engine parts—mainly small screw machine and turret lathe products. The concern took another building in Ferndale. One by one, Defense Plant Corp. additions went up, increasing floor space to 200,000 sq ft. The company took on more orders from Wright until it was making 120 different engine parts.

The employment roll boomed from 25 workmen to 4500, of which number 65 per cent were women, and most of them with no previous factory experience. Production mounted in proportion. In the list of Woodworth products are such items as cylinder head bolts, valve tappet guides, various pins and screws, and the sizeable Wright propeller shaft housing which is at present the largest job in the shop.

Two Classes of Work

The firm's business is divided into two general classes of work. There are the custom jobs calling for deliveries of several hundred units per month. Then there are the high-production jobs on which deliveries range upward from 25,000 units per month. Jobs in the first class, of course, do not call for the same degree of in-line processing and conveyorizing as those in the second class.

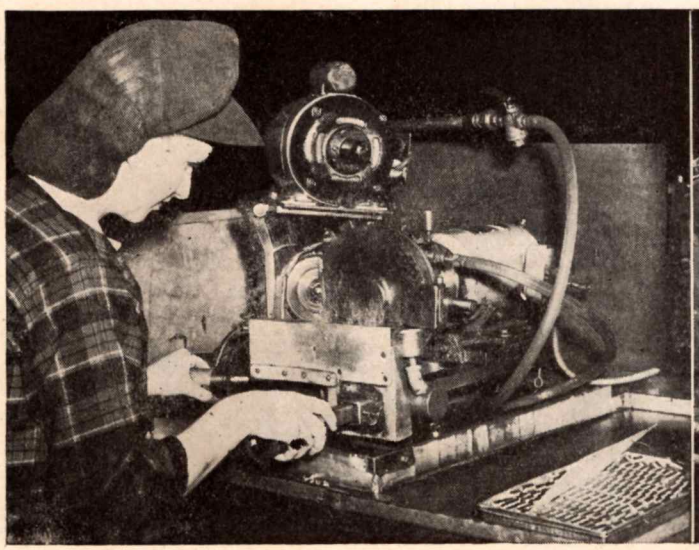
The rapid growth from a small tool shop to a large-scale producer has brought with it problems both in manufacture and in recruiting and training personnel. The company has frequently had to make its own machine tools to keep up with increasing schedules, and the plant contains many good examples of this type of self-help.

For instance there is the roller pin, the end of which has to be ground to a radius. Unable to wait for complete delivery of standard radius grinders, the company manufactured its own, a relatively small, bench-mounted tool consisting of a motor-driven grinding wheel and an oscillating fixture. Several of these jobs were built and put into operation. Today they are operating alongside the standard machines.

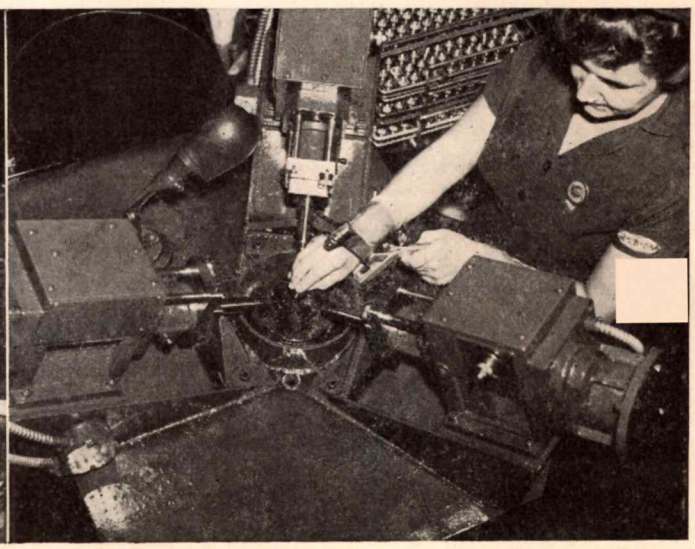
Another machine-tool bottleneck occurred in the grinding of the slot in the valve tappet guide. Instead of waiting for surface grinders that were on order, small bench grinders were built—featured by a plate, integral with the grinder, to guide the fixture holding the work. Because the machine is special-purpose, with a simple guide and fixture to insure accuracy, any inexperienced operator can handle the job. Now the plant has a half dozen such bench setups in operation and

(*Continued on page* 171)

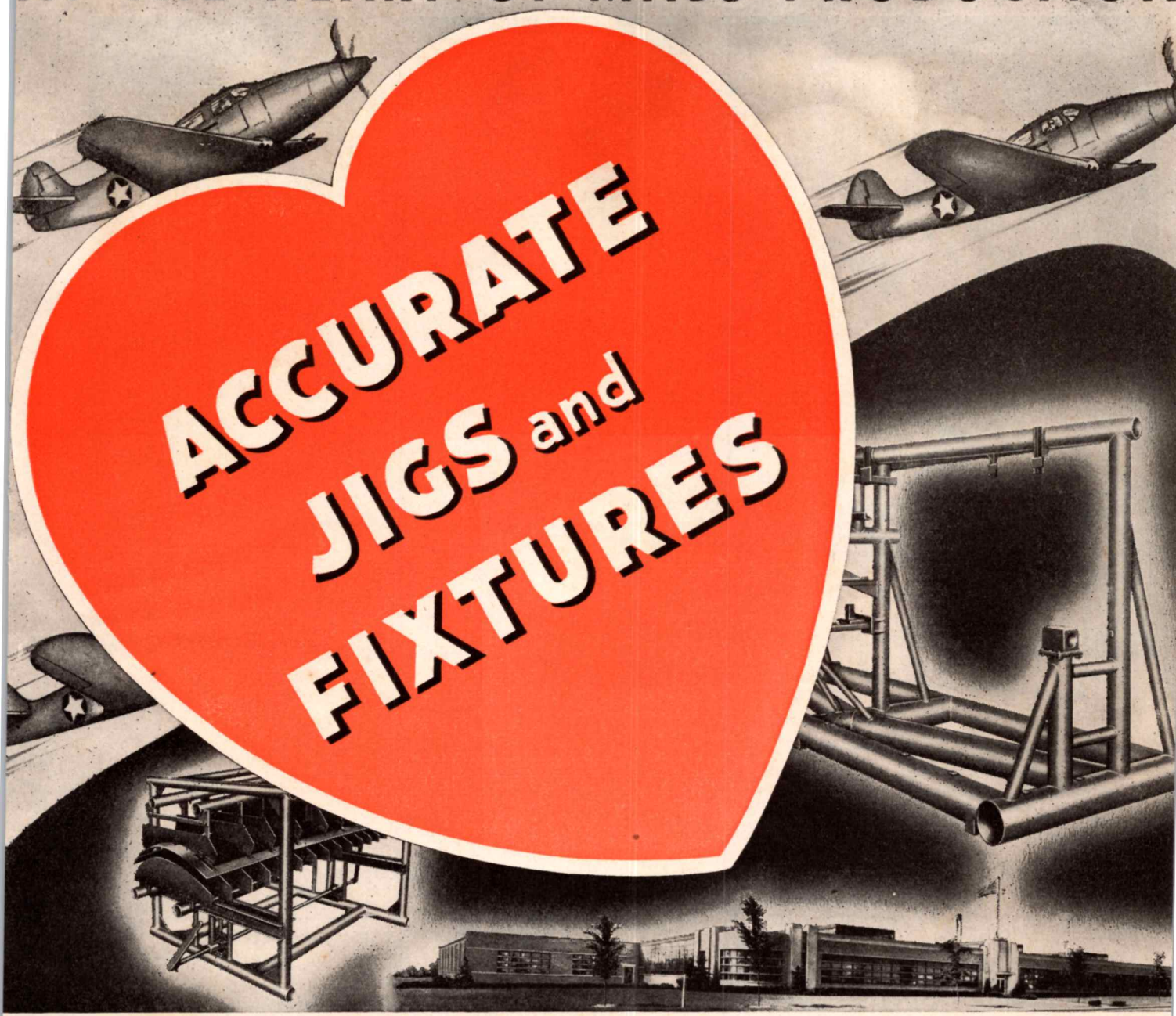
To eliminate a machine-tool bottleneck, the Woodworth Company built its own radius grinders



This three-spindle special purpose drill was designed for purpose of drilling oil holes in the adjusting screw



AT THE HEART OF MASS PRODUCTION



AMERICAN INDUSTRY performed a miracle of production in converting its peace-time pursuits to the tremendous needs of war. The Axis said it couldn't be done—that assembly-line methods and mass production timing wouldn't function with the highly-accurate, intricately-mechanized armament. We know better! And they're learning fast! Here at Herron-Zimmers, the ingenuity of our design engineers and the skill of our metal technicians turned almost overnight from the production of metal mouldings to the fabrication of the highly-accurate jigs and fixtures so vital to mass production.

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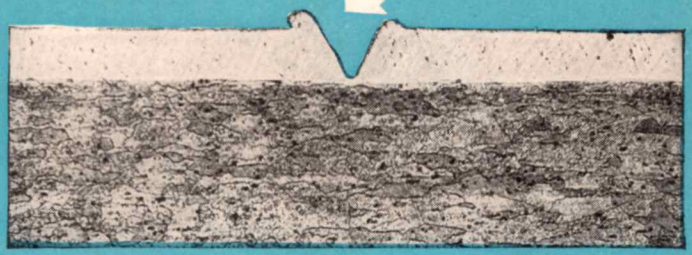


Scratch in alclad coating, magnified 100 times. Observers agree that scratches seldom penetrate to this depth.

" ---- In case of Alclad Aluminum Sheet, this material will not be rejected for scratches that do not extend through to the base metal."

Plane production was accelerated when Government Specification Agencies announced the above decision on what constitutes a "safe" or "unsafe" scratch in alclad aluminum sheet. Contractors were given a usable standard of quality. Though made some time ago, it is repeated here for the benefit of any workers in aluminum who may not be familiar with the ruling.

Data on which this decision was based have since been supplemented by considerable new data. All confirm and strengthen the original findings. Typical results of the newer tests are shown in the table at the right.

Even the deep scratch, penetrating to the base metal, had no effect upon tensile and yield strengths, and only a negligible effect upon the elongation and fatigue strength.

It was again concluded, therefore, that scratches which do not penetrate through the alclad coating and into the core are not cause for rejection.

EFFECTS OF SCRATCHES ON TENSILE PROPERTIES*

Average Coating Thickness, In.	Average Depth of Scratch, In.	Average Depth of Scratch, Percent of Coating Thickness	Tensile Strength, Psi.	Yield Strength (Offset Equals 0.2 Percent), Psi.	Elongation in 2 In., Percent
0.0026	0	0	62 105	41 200	20.3
0.0025	0.00150	60	62 810	42 000	19.0
0.0028	0.00288	103	62 730	41 850	16.0

*All stresses computed on basis of full thickness of sheet.

Reprints of the paper, "Effect of Scratches on Fatigue Strength of Alclad Sheet", discussing these findings in detail, are available. For a copy, write ALUMINUM COMPANY OF AMERICA, 2194 Gulf Building, Pittsburgh, Pennsylvania.

ALCOA ALUMINUM

(*Continued from page* 168)
surface grinders for this job are unnecessary.

There are also cases in the plant in which machines are set up to give a higher output with fewer operators. An instance is a battery of three Cincinnati centerless grinders, linked together by a work chute to perform successive grinding operations on the valve tappet. An operator feeds tappets into the trough at the first machine and another operator takes them out at the delivery end of the third machine and checks them. The conventional method of doing the job would be to assign two operators per machine and feed each machine separately. By joining the three machines in this manner the need for four operators is eliminated.

Three Spindle Drilling Machine

Of the elimination of machine-tool bottlenecks in drilling operations, an outstanding example is a three-spindle drilling machine manufactured according to Woodworth specifications to drill three oil holes at angles into an adjusting screw. One machine has been delivered and is in operation and another is on order. The two machines, both hydraulically fed, will take the place of ten conventional single-spindle drill presses.

On its high production job, the shop has adopted in-line methods for all machining operations. Part of the plant is devoted to long tables, with the work passing down the tables in a series of successive operations to the finished product. Similarly, inspection work on parts has been highly subdivided and conveyorized.

In the testing of the adjusting screw a number of unique devices have been installed. The parts travel from one inspector to another on a belt conveyor. The first inspector loads the parts, checking them for nicks and scratches. The second examines oil holes with a small plug gage, and the third employs a modification of the doctor's nose-and-throat lens—a lens containing a light bulb—to inspect the intersection of the three holes.

Company-Designed Thread Gage

Farther down the line threads are checked on a company-designed thread gage, which checks pitch and lead. The limits, in turn, are clearly indicated so that an inexperienced operator can make a satisfactory inspection. At the finish of the line, the conveyor belt dips down through an oil bath from which the screws emerge ready for packing.

Because of its tremendous expansion, Woodworth has encountered special problems in the recruiting and training of labor not faced by older companies with long employment rolls on which to draw. One result of this condition was that the company early began to employ a high percentage of women. The present 65% of women will become 80% before the end of the year.

One simple method of recruiting labor is to hand to each employee a "Referral Card." The employee in turn gives this card to a friend on the outside. The card entitles the visitor to a personal interview with the employment director. It gives the prospect an "in" and makes her feel that she is getting personal treatment.

Part of the reason for the general good attitude and high performance record of women employes, according to Donald E. Wright, public relations director, is the care with which the company has placed girls in jobs in the first place.

If a girl of relatively slow reactions as to muscular dexterity is placed on a complicated job—one requiring a number of tools and a certain amount of alertness and speed—her inability to handle the job will set up an attitude of resentment and dissatisfaction. This same girl, on degreasing, washing, shipping or some other easier task, is often a highly satisfactory worker. On the other hand, if a mentally and manually alert girl is placed on a low-skill, repetitive job, she will be equally unhappy and will probably do a poor grade of work.

This, however, involves knowing something about the employes before they're hired. The company has therefore installed a series of tests that every prospective employe must take.

Reveals Emotional Stability

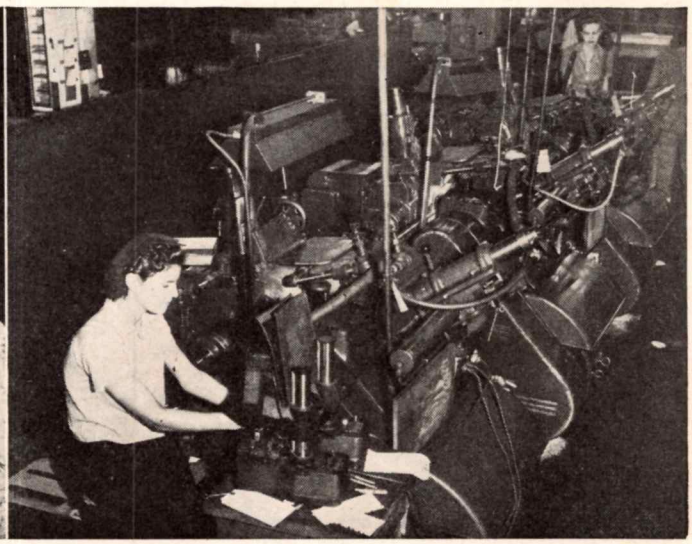
The first test is a standard 73-question intelligence test, on the results of which every candidate is given an I.Q. rating. This test, though supposed to take half an hour, is given in twenty minutes in order that the employment office may have an opportunity to obtain a rating on the person's speed as well as her judgment.

The second test, a series of questions on paper (as is the intelligence test), reveals the person's emotional stability. The kind of answers given afford the company a remarkably accurate measure of the person's emotional nature, her tendency to fly off the handle or to quarrel.

The third test is the McQuarrie mechanical aptitude test in which a girl's ability to draw diagrams, to "see" geometric shapes and reproduce them, and the like, is a valid guide to her mechanical ability.

A physician's nose-and-throat lens helps the inspector to see inside an adjusting screw to junction of three oil holes

Two operators tend these three centerless grinders linked together by a work chute to eliminate need for four operators



PARALLEL OPERATION OF AIRPLANE ALTERNATORS

D. W. EXNER,

Westinghouse Electric & Mfg. Co.[1]

ELECTRICAL loads on military airplanes have increased tremendously in the last three years because of the substitution of electric power for hydraulic power to drive auxiliaries, or the use of motor-driven instead of engine-driven hydraulic pumps, and because of the development of new flight and combat devices. The increase in airplane electrical loads has made necessary an increase in the distribution voltage to avoid excessive copper weight. Difficulties in the use of higher d-c voltages are mentioned and past experience with a 400-cycle three-phase system is outlined.

Progress in 400-Cycle System

In the light of this experience and of new developments in progress, requirements are outlined for a larger 400-cycle system with multiple generating units operating in parallel. First in use because of its simplicity, the d-c system progressed through the 6- and 12-v stages until, in 1939, new airplanes were designed with a 24-v system. As the loads increased, the weight of wiring required for the lower-voltage systems became prohibitive. Now, in 1943, the economical limit of the 24-v system has been exceeded, with new airplanes demanding 1600 to 2000-amp peak loads.

A further increase in voltage is therefore necessary. Because of the continued upward trend of the load demand curve, and because of the increasing transmission distances in the larger airplanes, the next step will be above 100 v.

Unfortunately a change to 115-v d-c on high-altitude airplanes introduces at least one problem to which a completely satisfactory answer has not yet been found. This is the difficulty of arc-rupturing in the switching equipment at present and contemplated flight-altitude maxima for combat airplanes. Fault currents may be higher than for a-c equipment of equivalent rating. On small motors at this voltage commutation at high altitudes is another problem. Partly for these reasons, the AAF has selected a 208/120-v 400-cycle 3-phase 4-wire system for the large combat airplanes now under development.

Early Experiments by Air Corps

Early experiments by the Air Corps with a-c auxiliary power on the *XB-15* resulted in procurement of auxiliary-engine-driven 400-cycle 3-phase power plants for the *XB-19*. Fig. 1 is a schematic view showing the circuit arrangement. The design of the engine and alternator was co-ordinated to result in a package unit (fig. 2). The pancake proportions of the alternator do not give the optimum weight of electrical parts, but in conjunction with the aluminum fan, provide the necessary flywheel effect for the engine. The use of 14 poles gives a synchronous speed of 3430 rpm. The short-circuit ratio is 0.60, a figure which may seem low to a designer of 60-cycle machines, but which has proved satisfactory in operation. Heavy dampers with continuous end rings limit oscillation caused by engine torque pulsation. They also help support the voltage until the regulator responds to a load increment. With a self-excited system this materially assists in prompt recovery of voltage if the regulator is fast enough to take advantage of it.

[1] Paper presented at the Salt Lake City meeting of the AIEE Sept. 2-4, 1943.

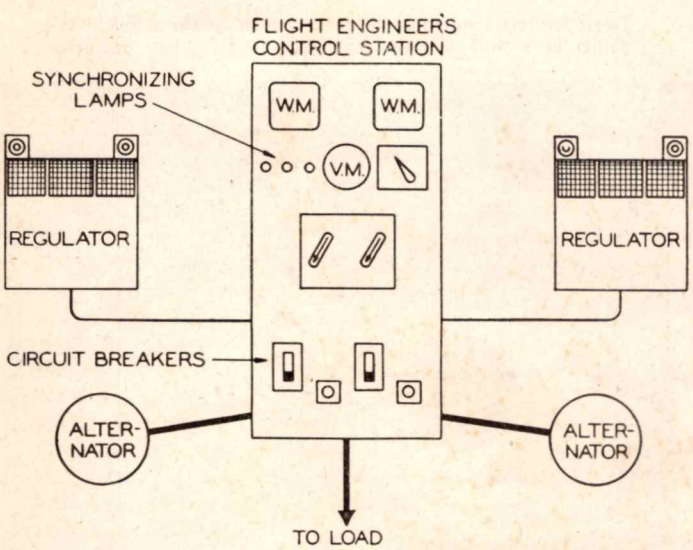


Fig. 1: Schematic view of auxiliary power-plants used on the XB-19 airplane

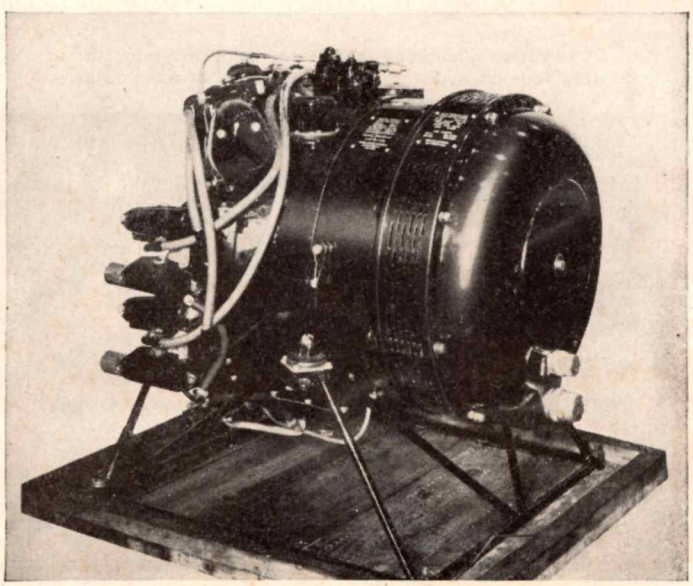


Fig. 2: 12.5-kva alternator assembled on Ruckstell-Burkhardt auxiliary engine

The design rating of the alternator is 120 v, 12.5 kva, 0.80 power factor, although to conform to the Air Corps specification, the nameplate rating is 10 kva, 0.75 power factor. As the system is operated underground, the neutral is not brought out.

The rotating field of the alternator is designed for overhung mounting on the engine crankshaft, which makes the use of a d-c exciter difficult. Largely for this reason it was decided to use self-excitation. An electronic voltage regulator, using *RO-585* diodes to control a 3-phase half-wave thyratron rectifier, provides the fast-acting field supply so necessary in a self-excited system.

Operation of Filaments

The *RO-585* filaments are operated from a positive-phase-sequence network which delivers a single-phase voltage proportional to the average of the rms values of the 3-line voltages. As the regulating action is a function of the filament temperature in these tubes, the regulator is responsive to the average of the three rms phase voltages. An incidental advantage in using the positive-sequence network is the accomplishment of excellent temperature compensation by using in the resistance element of the network a material having a positive temperature coefficient of resistance.

The flight engineer's panel (fig. 3), contains the instrumentation and manual controls. The panel compartment houses the voltage build-up and reactive-load-equalizer circuits, the wattmeter current transformers, and the manual circuit breakers. Voltage is built up initially from an alternator residual voltage of approximately 9 v by means of a copper-oxide rectifier and a small multi-contact *Silverstat* voltage regulator, both of which are intermittently rated to supply no-load excitation. A small high-reactance step-up transformer overcomes the initially high resistance of the rectifier without resulting in excessive excitation at normal voltage. By this means the voltage overswing is reduced. For each alternator a 3-position multi-contact manual cam switch controls the starting sequence. This switch must be in the OFF position before the auxiliary engine starter circuit can be completed. With the engine at normal speed, the switch may be turned to the WARM-UP position, which allows the voltage to build up and be maintained under the control of the auxiliary regulator. After 45 sec a thermal relay energizes a tripping magnet on the cam switch, automatically advancing the switch to the RUN position, although it may be returned to the OFF position at any time. The two cam switches are mutually interlocked to prevent an attempt to build up both alternators at the same time, as only one build-up circuit is provided. As soon as one alternator is transferred to electronic regulation, it may be connected to the load bus by closing its manual circuit breaker although, particularly at low ambient temperature, it is desirable to operate at no load for a few minutes to allow the thyratrons to reach normal operating temperature.

With no load on the first alternator, and with the governors of the two engines closely matched, it has been found fairly easy to synchronize manually at full voltage on every attempt when the synchronizing lamps are flashing not faster than three cycles per sec. At rates of slip up to six or eight cycles per sec it is possible to synchronize on approximately 75% of the attempts with random closure of the breaker. With more than two or three kw of load on one alternator it is necessary to close while the lamps are dim or dark. Test experience with these powerplants indicated the necessity of manual control of the engine governors, and this feature was added when the equipment was installed in the airplane. After some practice, and with the engines in smooth running condition, it was then possible for the operator to synchronize with full load on one alternator, although he would occasionally miss. When the engines have been run for a number of hours after an overhaul, momentary speed changes during attempts to synchronize make it difficult to do so with more than six kw of load.

During the development stage, tests were made to determine if it were practical to synchronize by bringing the incoming alternator up to approximately synchronous speed with zero or weak field, and allowing it to pull into step by means of its damper winding and reluctance torque. This attempt was not successful because the highly reactive load severely overloaded the first alternator. While it is true that better results would have been obtained with separately excited machines, the shock would still be prohibitive when

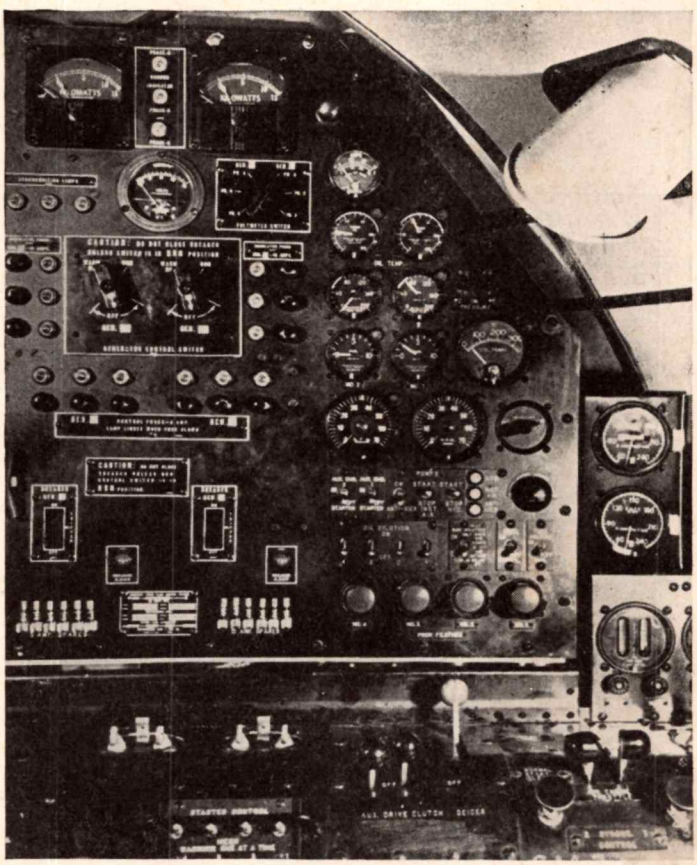
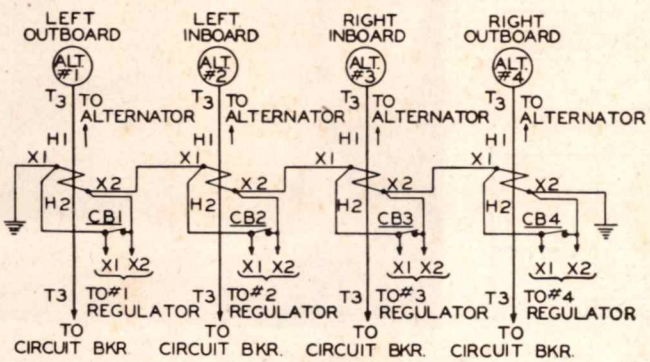


Fig. 3: Alternator and auxiliary engine instruments and manual controls at the flight engineers' position of the XB-19

Fig. 4, below: Standardized current transformer interconnections for feeding reactive load equalizer networks of voltage regulators



attempting to synchronize under load.

When paralleled units are driven by auxiliary engines, it is necessary to cut off promptly an alternator whose engine has failed to carry load. Magneto trouble, fouled plugs and vapor lock, or other fuel-system faults, will occasionally cause a short-time or sustained power failure. Any tripping means for isolating such a unit should have its action delayed sufficiently to prevent operation on a momentary misfire which can be sustained by the inertia of the machine. On this equipment, protection is afforded by a reverse-power contact on the wattmeter which actuates a shunt trip magnet on the circuit breaker. This contact is set at three kw, and the damping of the instrument gives the necessary delay. A small pilot relay inside the instrument case relieves the pointer contact of the tripping current.

Experience with the system has demonstrated the desirability of a uniform response rate of the several governors. If the rates differ materially, one engine tries to drive the other on the sudden removal of a large load, and faulty tripping of the reverse-power device may result. A particularly bad performer is a governor which has sluggish response in correcting overspeed. Although the condition was reproduced during preliminary testing, no serious trouble has been experienced in service operation.

Experience with the scheme for automatically building up the alternator from its residual voltage has been generally good but subject to occasional failure caused by a reduction of normal residual flux. This usually follows a shutdown caused by loss of voltage resulting from a highly-inductive overload, and may occur after an engine failure has transferred all of the load to the remaining alternator. It may also be discovered after the flight engineer has mistakenly shut down an engine without first opening the alternator circuit breaker. To overcome this condition a circuit has been added which permits the operator to "flash" the field with battery voltage if necessary.

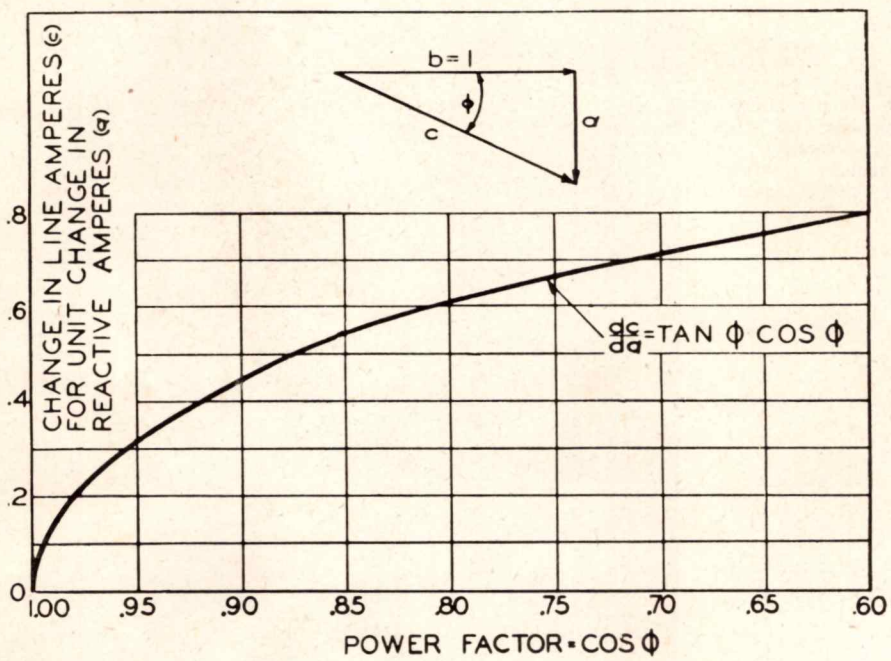
Having examined an existing a-c installation, we may proceed to lay down the requirements of an airplane power system which will take advantage of the experience gained and the newer developments available. It cannot be denied that a successful system must involve parallel operation of a number of generating units. It is not acceptable that the loss of a single unit can shut down the whole system. The loss of one unit out of two is nearly as bad unless the essential load is within the rating of one generating unit. This condition might exist in a non-combat airplane but the greater hazards of combat operation dictate the use of at least three and preferably four units where the size of the airplane permits. Non-paralleled or isolated operation of the several generating units is a makeshift which does not use to the full the power capabilities of the system in starting heavy motor loads and self-clearing of faults, i.e., the load factor with separate units is poor. Loss of a generating unit results in a delay before the load can be reapportioned among the other units.

The ability to parallel alternators depends first on the characteristics of the prime movers. The earlier a-c aircraft systems used auxiliary gasoline engines governed to run at essentially constant speed. The governors are designed to droop the speed slightly as load increases, which characteristic automatically gives acceptable division of kw load between units. As the capacity of the prime mover is comparable to that of the alternator and the inertia is relatively low, no difficulty has been experienced in maintaining synchronism under all conditions, including load transients. In the *XB-19* equipment, the use of low-resistance damper windings effectively prevents hunting caused by engine torque pulsations. Whereas the use of auxiliary engine drive may be satisfactory for medium-altitude transport and cargo airplanes, at the present time it seems to be impractical to supercharge the smaller engines to a critical altitude sufficiently high to permit their use on high-altitude bombers.

Until recently no suitable means were available for driving alternators from the main engines and at the same time permitting parallel operation. Now several so-called "constant-speed" drives are under intensive development and promise to have the necessary performance. The input-output speed ratio is continuously variable so that a constant output speed may be main-

(*Continued on page* 298)

Fig. 5: Rate of change of ammeter reading with respect to the reactive component of current, plotted against power factor



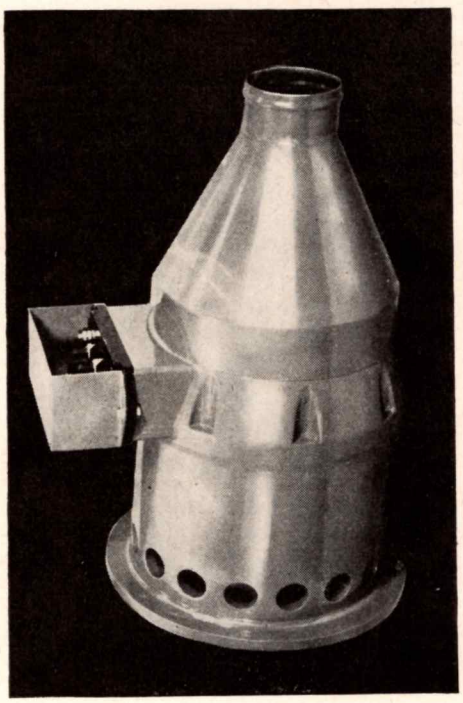
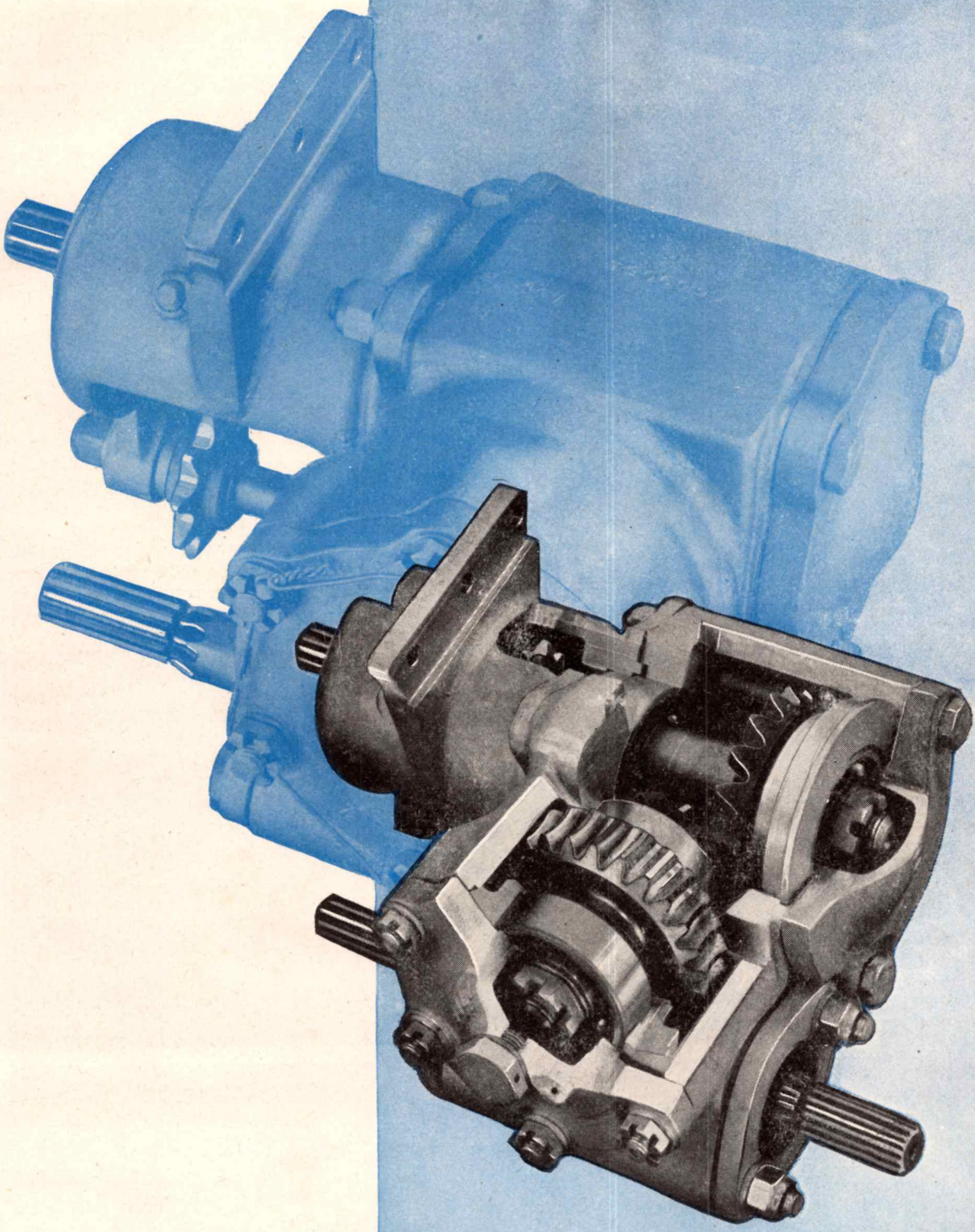


Fig. 6: Mock-up model of 40 kva alternator of current design



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ADVANTAGES OF METAL-BACK CHAFING STRIPS

BERNARD GROSS
Process Engineer, Rohr Aircraft Corp.

● Several methods are in use to prevent chafing between metal parts on aircraft. One requires the drilling of holes and the insertion of a round rubber-like button. While this procedure is suitable in some cases, it has certain disadvantages in others. For example, on some surfaces, the installation of parts is such that the buttons are forced out of the holes before the part is in place. Also, on a curved flanged surface, it is often difficult to drill holes for buttons.

Another disadvantage of the buttons is found in certain applications in which an air seal is required as well as means for the prevention of chafing. The fact that there is an air space between the buttons is responsible for the lack of seal when buttons are used. Buttons cannot be used where the surface is too narrow—in which case a relatively large hole is required to accommodate the button.

Another common method employed to prevent chafing involves the application of strips of rubberlike sheet, attached in any one of several ways, which calls for cementing, riveting and the drilling of holes in the material, through which are forced little knobs that are molded to the strip. There are disadvantages in the use of rubberlike sheet material applied by the above methods. The sheet, which is cemented or riveted, can not be secured satisfactorily without the expenditure of much labor and time.

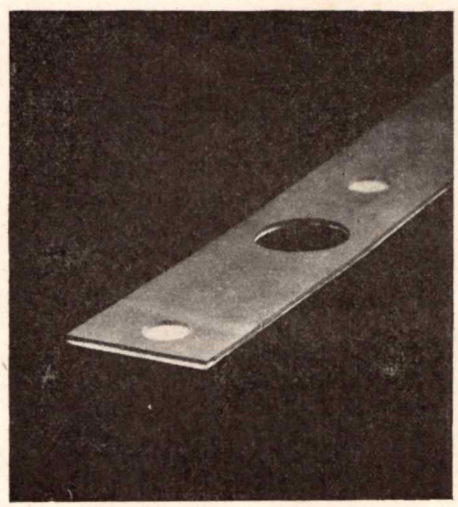


Fig. 1: Typical metal-back chafing strip

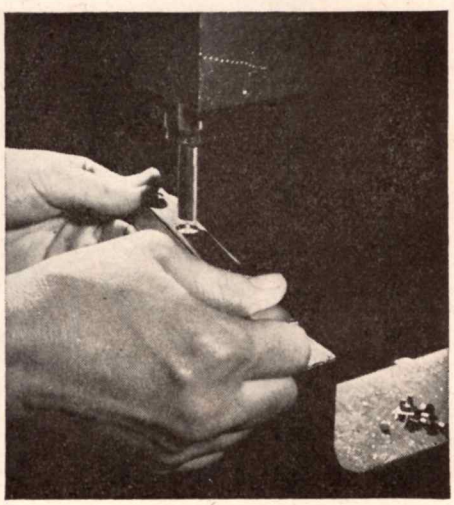


Fig. 2: Riveting of a chafing strip

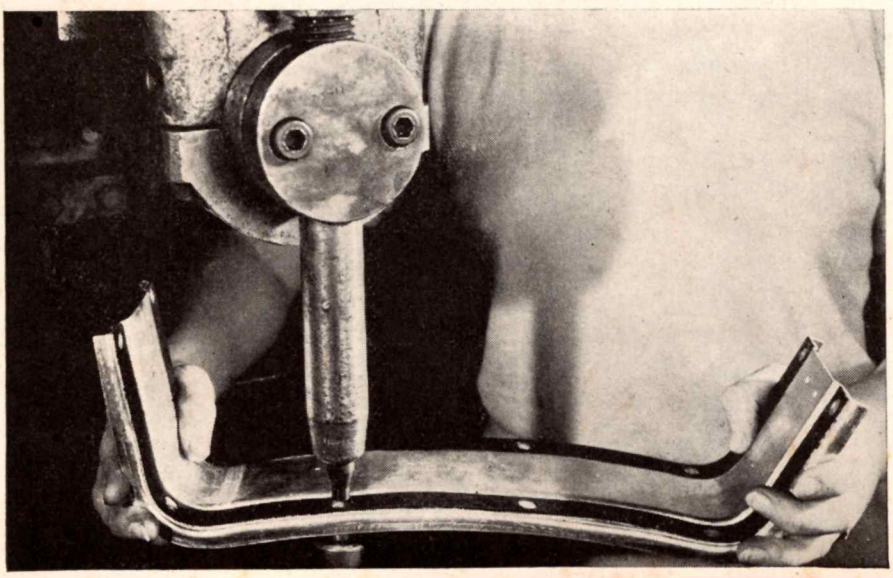
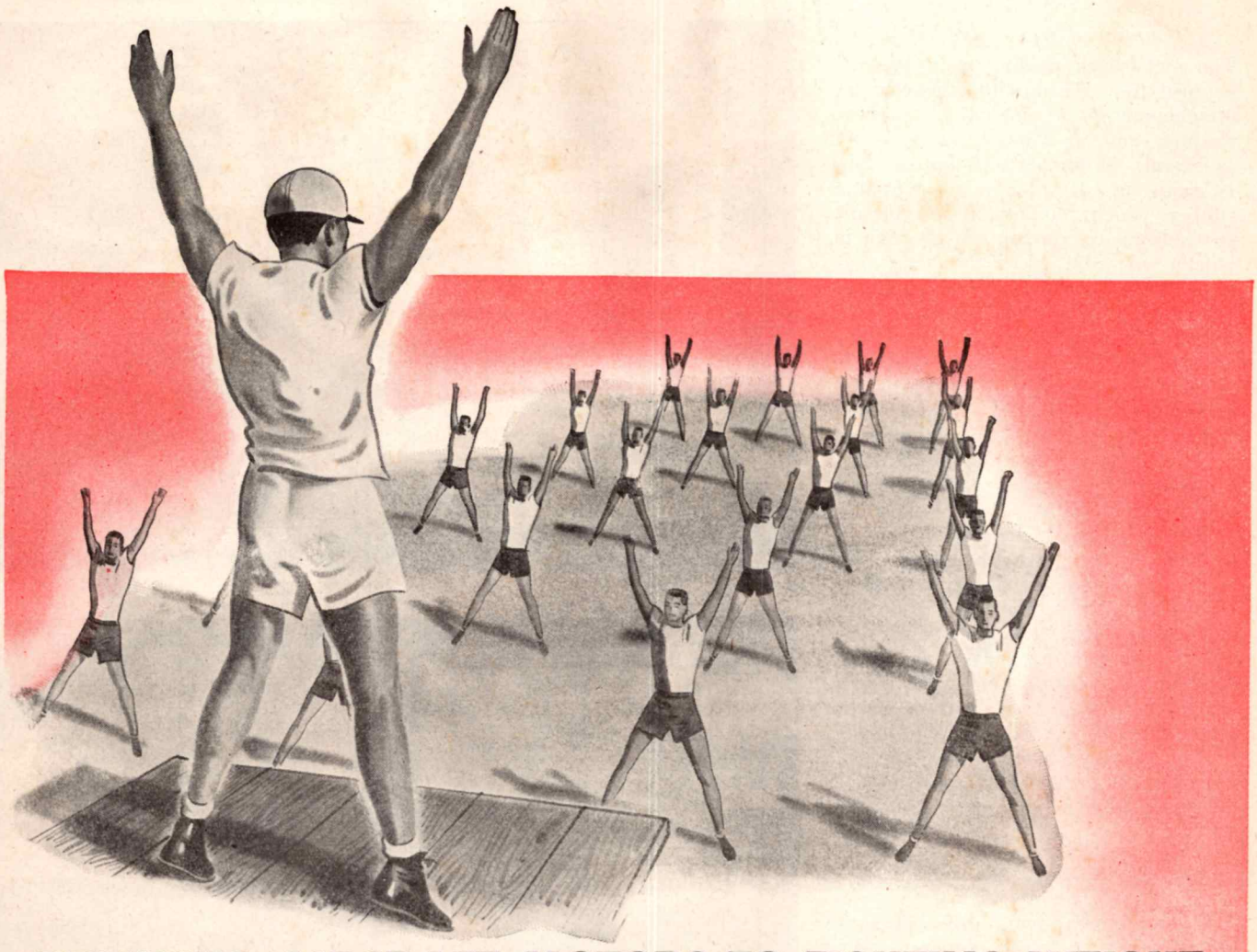


Fig. 3: Spotwelding operation used to secure chafing strip to a part

For example, to properly cement rubberlike sheet to aluminum, two different cements are sometimes used which require from 1 to 2 hr for setting up. Special tools are sometimes needed to apply sufficient pressure to the sheet to obtain adhesion. In the case of rivets, the rubberlike material tears out around the rivets and frequently moves when bonded by cement of the cold setting type.

A good production method for applying chafing strips with sufficient adhesion, therefore, became desirable.

(*Continued on page* 178)



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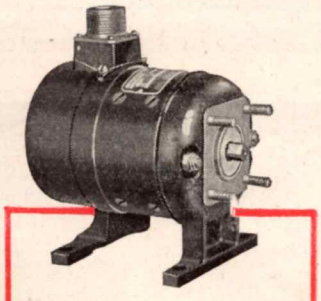

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(*Continued from page* 176)

The metal-back chafing strip was developed to make possible the efficient attachment of a surface to prevent chafing, and in some cases to serve as a seal. A metal-back chafing strip is made up of a strip of synthetic rubber which has cutouts to permit spotwelding or riveting, and which is vulcanized to a piece of metal that is in turn spotwelded or riveted to a structure.

Fig. 1 illustrates one end of a typical metal-back chafing strip. The hole through this particular unit provides access to a Dzus bolt. Fig. 2 illustrates a spotwelding operation used to secure the metal-back chafing strip to a part. Fig. 3 pictures the riveting of a chafing strip.

The metal-back chafing strips can be clamped to a structure just prior to the spotwelding of the structure. The chafing strip then becomes one of the many parts assembled for spotwelding or riveting. This new type of chafing strip not only eliminates routing of parts to some station where cementing is done, but also eliminates routing of large parts to still another department for the vulcanizing of the sheet rubberlike stock to the part itself.

New Strips Save Manpower

Fig. 4 pictures several different chafing strips used on a super-charger duct. Fig. 5 (A and B), illustrates that part which has been equipped with both methods being discussed. (A) shows the use of metal-back chafing strips and (B) pictures the riveted and cemented chafing strips. A comparison of manpower requirements for assembly application of riveting and cold-cemented strips versus welded metal-back chafing strips, for the parts illustrated in fig. 5, revealed a saving of approximately 80%.

The weight studies show the difference to be negligible. This is so, because a thinner rubberlike sheet stock can be used for the metal-back chafing strip than is ordinarily permissible. For example, where 1/16-in sheet was used in a cemented application, 1/32-in sheet vulcanized to 1/32 in of metal-back strip can be used. This procedure eliminates the need for an engineering change, because no change of over-all thickness is necessary if it is desired to replace the older type by the metal-type chafing strip.

Fig. 6 shows a super-charger duct with installation of metal-back chafing strips containing rubberlike extrusions. The same extrusions are shown riveted, in fig. 7. The simplicity of fabrica-

(*Continued on page* 180)

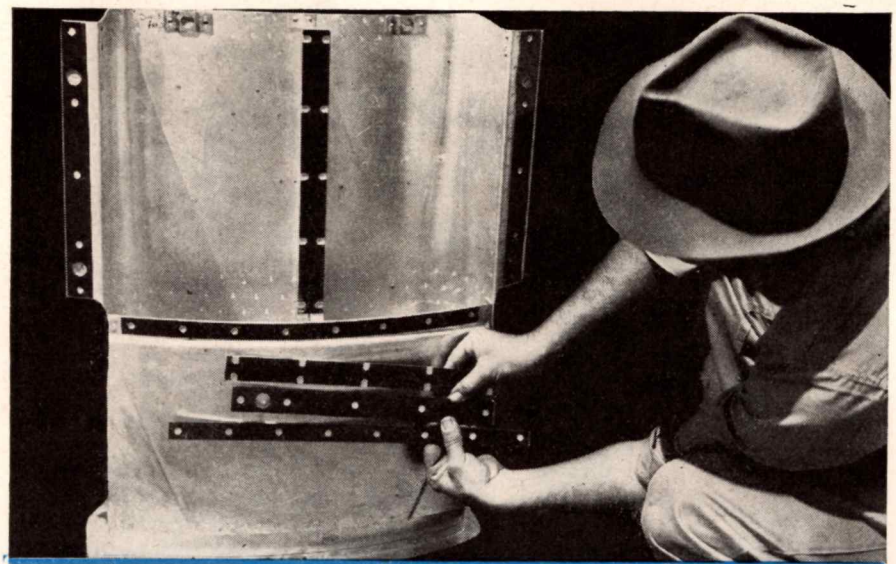

Fig. 4: Several different chafing strips used on a supercharger duct

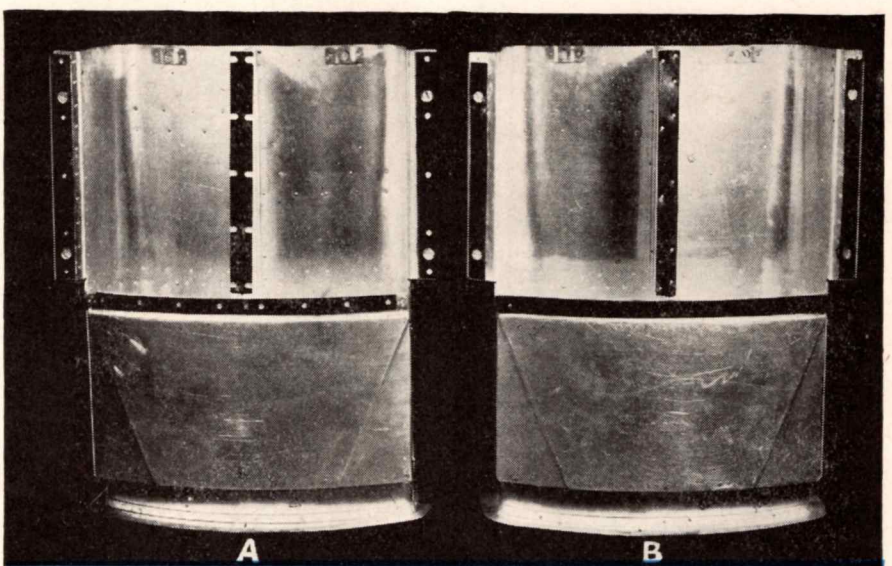

Fig. 5: (A) Metal-back chafing strips; (B) riveted and cemented strips

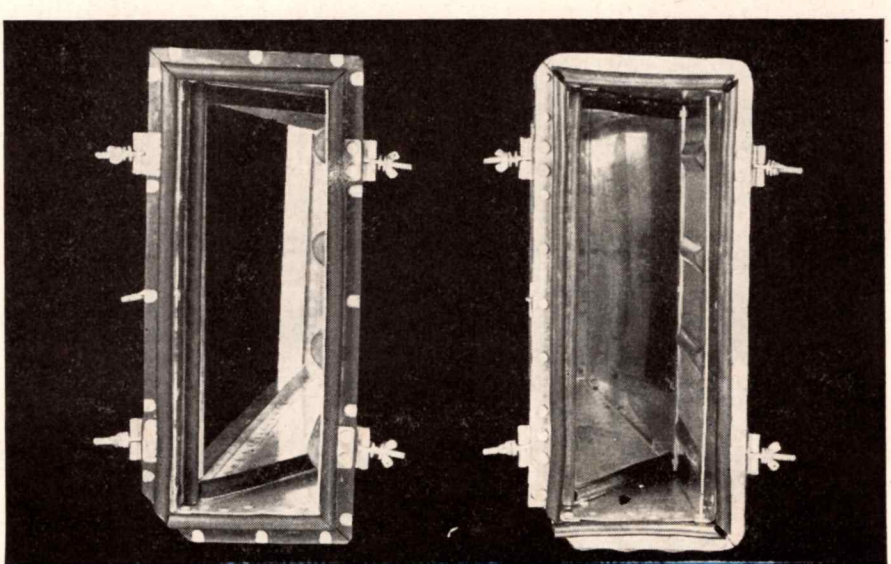

Fig. 6: Supercharger duct with installation of metal-back chafing strips

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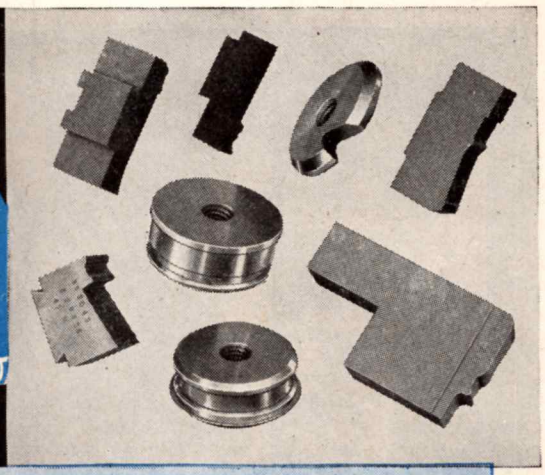

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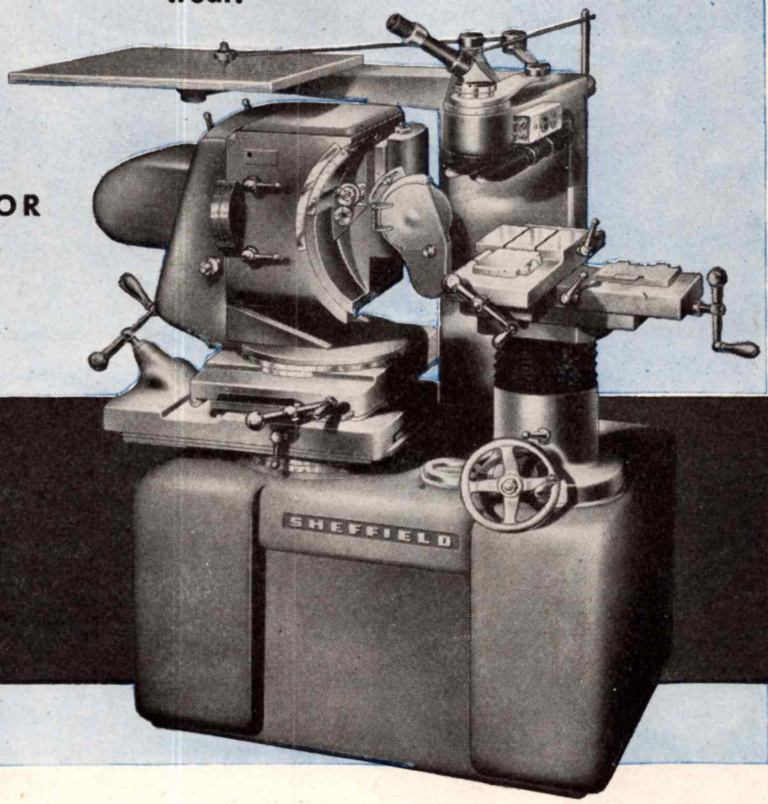

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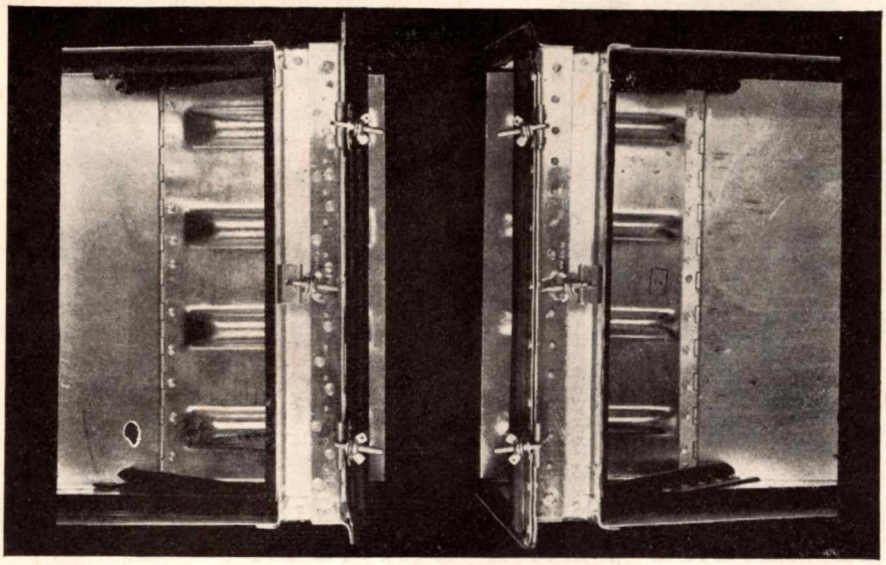


Fig. 7: Here the rubber-like extrusions shown in fig. 6 are riveted

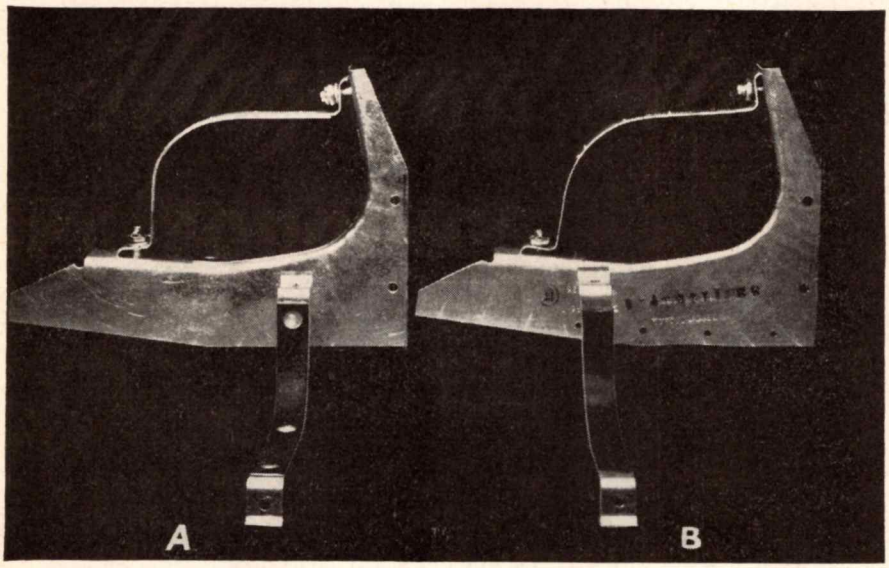
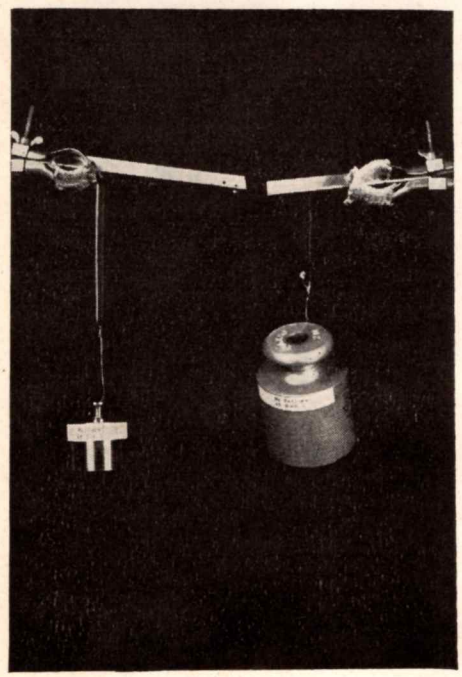


Fig. 8: (A) Metal-back chafing strip and (B) a cemented one, used on curved flanged surface



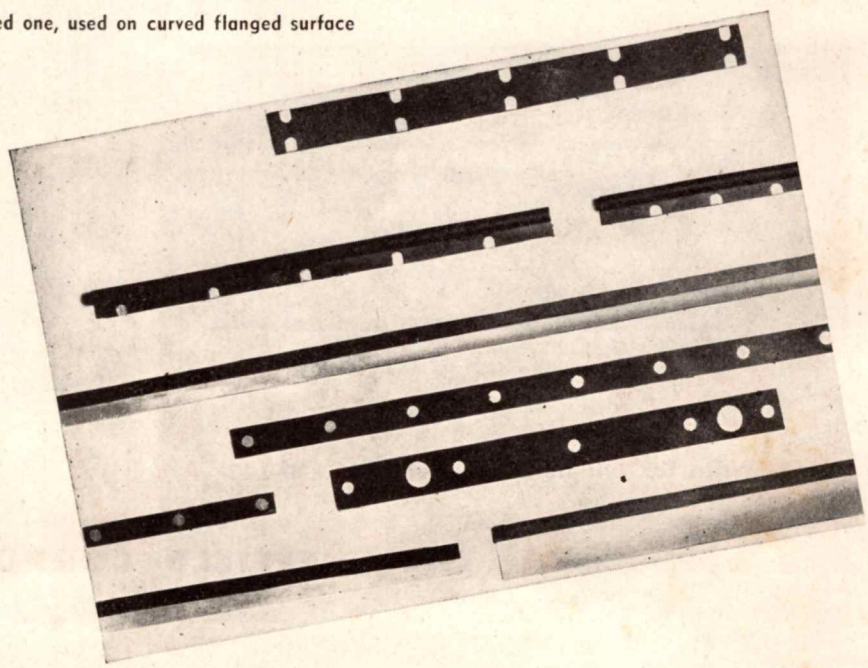


Fig. 9 (left): Comparison of a cold-cemented and a vulcanized strip

(*Continued from page* 178)

tion as well as the superior resulting assembly, when metal-back chafing strips are employed, are readily obvious in this case. Fig. 8 (A and B), shows a metal-back chafing strip as used on a curved flanged surface compared to a chafing strip which has been cemented and secured to the flange by means of small holes and molded knobs in the rubberlike strip. In this case, the necessity for drilling holes in a curved surface to accommodate the molded knobs was eliminated.

Comparison of Adhesive Qualities

A comparison of the adhesion of the cold-cemented strip and the vulcanized strip used in the metal-back unit is illustrated in fig. 9. In the case of the cemented strip, a pull of 500 grams readily tore a ½-in synthetic rubber strip from its metal base, whereas 2000 grams did not tear a synthetic rubber strip of the same width which had been vulcanized to its metal backing, even though the rubberlike strip was being stretched considerably. The additional structural strength resulting from the use of the metal-back chafing strip, is a consideration which the designer should keep in mind when composing a unit requiring chafing strips.

The applications of the metal chafing strip are too numerous to mention in this paper. Some of the variations are pictured in fig. 10.

Fig. 10 (below): A variety of chafing strips

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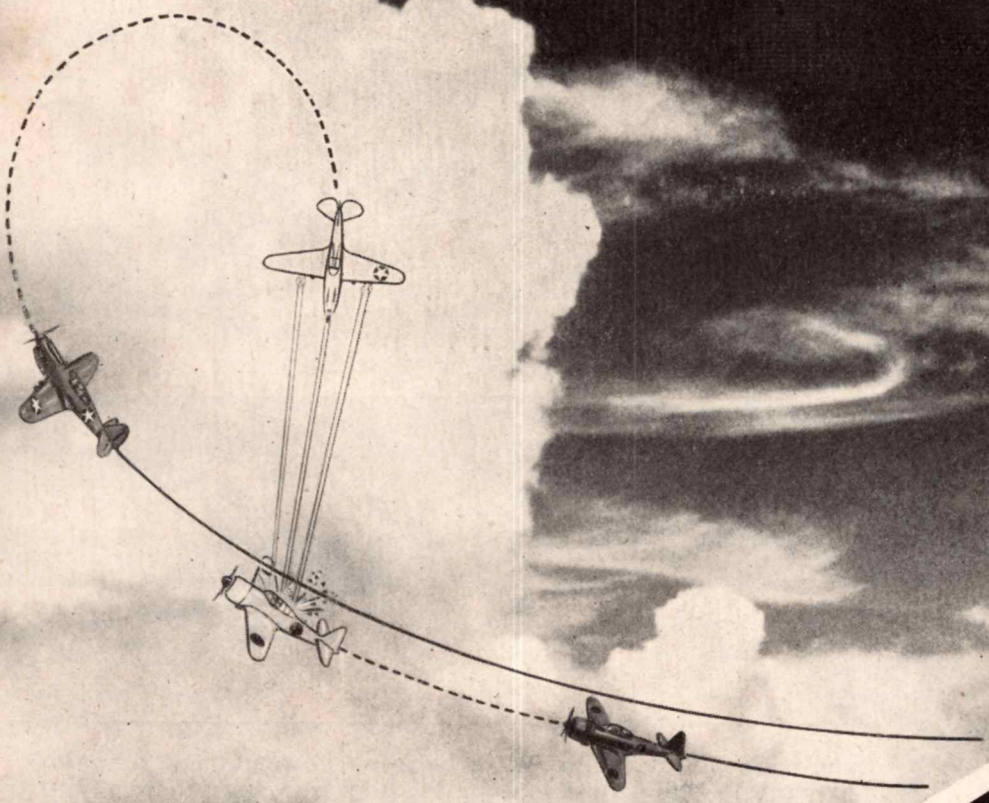

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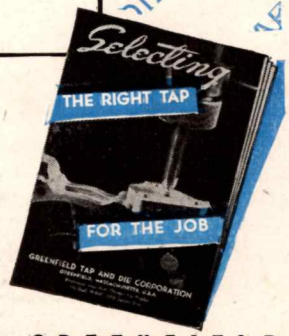

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"Cycleweld" Technique for Joining of Aircraft Parts

F. M. RECK, Detroit Editor

● Airplanes of the future are likely to contain considerably less spot welding and riveting than present craft, if the new cyclewelding technique of joining airframe parts continues to progress as rapidly as it has in recent months.

Cyclewelding is a cementing process using a thermosetting plastic under heat and pressure to join metal, wood to metal, metal to rubber, and metal to plastic. It was developed by S. Gordon Saunders, production research engineer of Chrysler Corp., in cooperation with the AAF Material Command in Dayton, Ohio, and the Navy Bureau of Aeronautics in Philadelphia.

S. G. Saunders, production research engineer who developed the Cycleweld process for Chrysler

Tests of Cyclewelded Joints

Tests of cyclewelded joints in comparison with riveted ones have been startling. The shear strength of certain cyclewelded joints, for example, has been almost twice that of riveted joints. The impact strength has proved to be many times greater and the creep strength at least 50% greater. Of great importance, too, is the fact that cyclewelded aluminum joints have been unaffected by vibration; in every vibration test the metal itself, remote from the joint, has broken before the joint has separated.

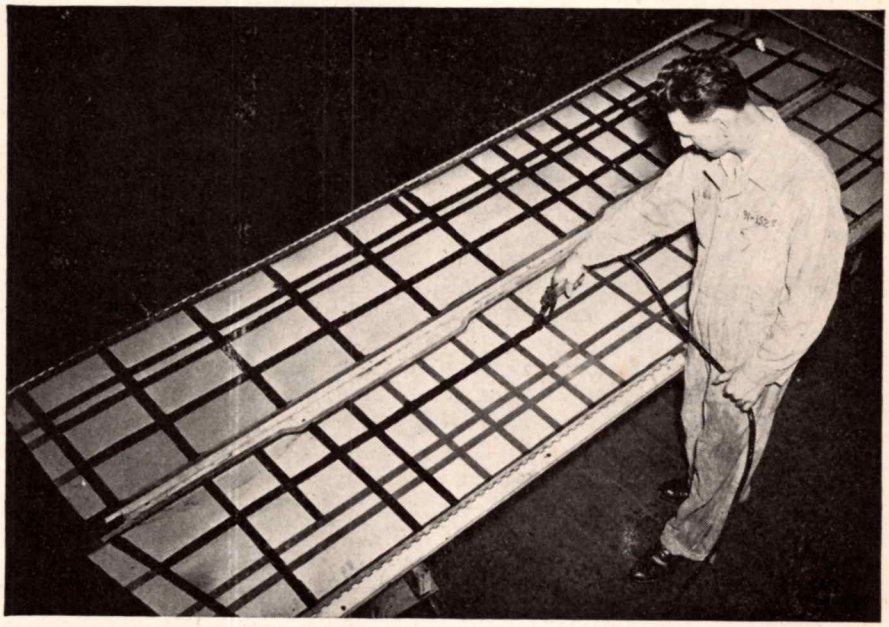
According to Saunders, the conclusion has been reached that cyclewelded joints are stronger than either riveted or welded joints, chiefly because the joined area is greater. Both spot welding and riveting provide small, localized junctions, whereas cycleweld ing affords a continuous strip or an entire bonding area.

It is also true that cyclewelding avoids certain handicaps of the two older processes. In riveting, holes must be drilled, and the holes have the effect of weakening the metal. In spot welding, there are such hazards as the deposit of copper in the weld, or a change in the alloy that tends to weaken the metal. Cyclewelding avoids these weakening effects.

Because of these virtues, cycleweld ing has already been incorporated into the production of many airframe parts. Chrysler is using the process in many subassemblies such as wing flaps, stabilizers, bomber flooring, heat ducts, modulator boxes and the like. About 40 manufacturers throughout the country are employing the process and their number is growing. For

In assembling the wing flap, a worker with a gravity feed flow gun applies cycleweld cement to the structural members

Liquid is striped on the aluminum skin of the wing flap by following the markers

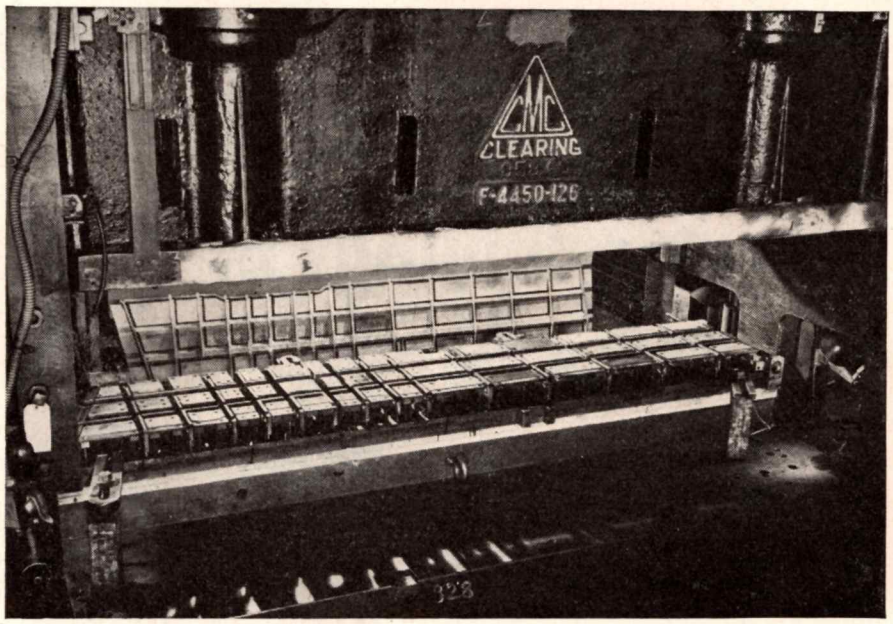


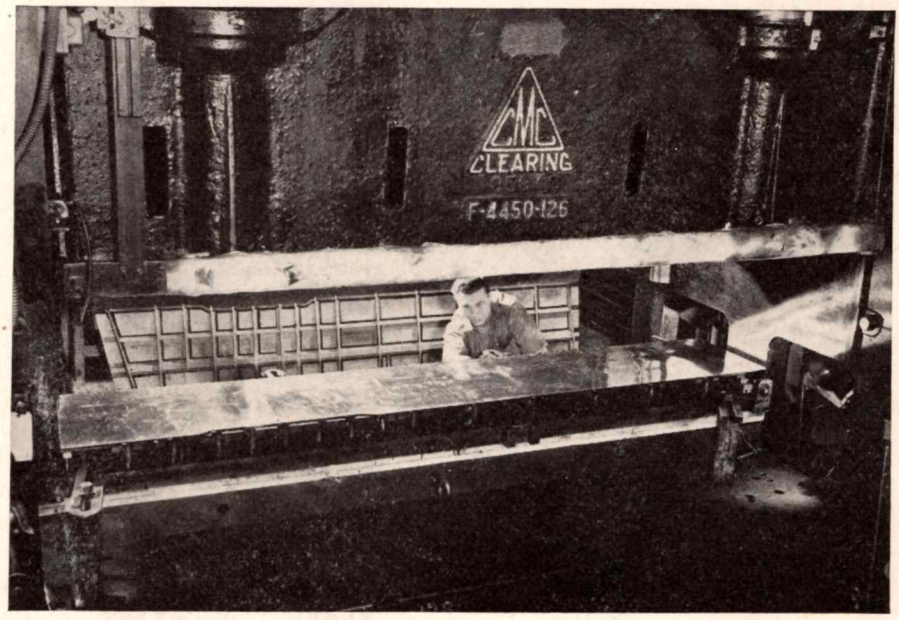
the duration of the war, Chrysler has offered cyclewelding free to any company engaged in war work.

The cyclewelding method involves the use of a cement. The cement is available as a liquid, in which case it is painted on the surfaces to be joined with a brush, or as a tape, in which case it is laid on. Manufacture of the tape has been commercialized to such an extent that it is now available in practically any width required by manufacturers.

Before the cement is applied, the surfaces to be joined must be chemically cleaned. Then the part is placed in a press or a special fixture for the application of heat and pressure. These may range from a small toggle clamp fixture with a cartridge heater to a large press accommodating an entire flap or stabilizer.

From this description it will be seen that cyclewelding cannot entirely replace riveting, since cyclewelding requires the positioning of a fixture on both sides of the work, whereas in riveting a bucking bar can be inserted into a restricted space where there would be no room for a fixture. Whenever the work cannot be conveniently placed in a press or a fixture, riveting must be resorted to.





Above: In this press, the structural members of the wing flap are cemented together. Below: Here, the skin is shown about to be cemented to the structural assembly of the wing flap

Same Set-Ups for Both Procedures

Parts set up for spot welding, however, can be cyclewelded without difficulty, since both processes require the use of a machine or fixture that can be brought into contact with both sides of the work. Thus cyclewelding is used to bond aluminum skin to stringers of a certain fighter-plane wing flap, where formerly riveting was used. Incidentally, the introduction of cyclewelding on this wing flap reduced the complete assembly time by about one-third, and the product has proved to be both stronger and more rigid.

The process offers many advantages to the airplane builder. It is an important weight saver. On a certain stabilizer, for example, the number of rivets was reduced from 5500 to 30, with a considerable resultant saving in weight. On an experimental wooden airplane cycleweld eliminated nuts and bolts on the most important beam fittings, thereby saving several hundred pounds.

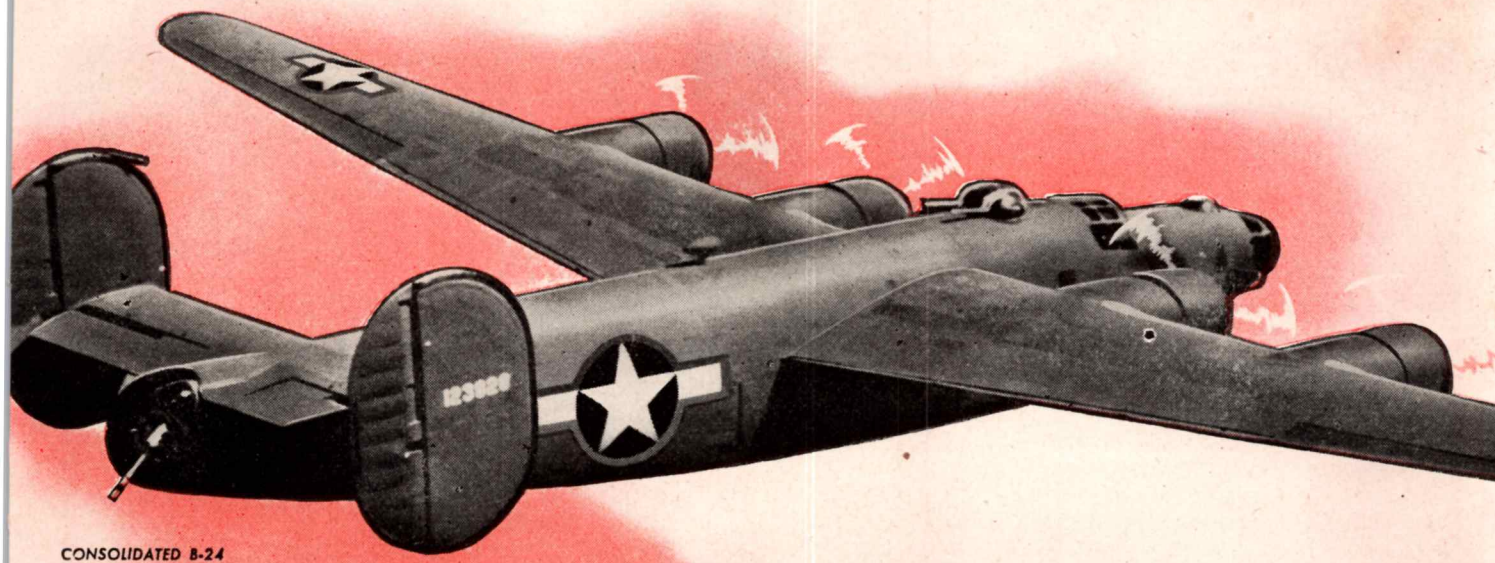
Saunders believes, however, that the full benefits of cycleweld will not be realized until airplanes are so designed as to take full advantage of the new process. Thus, spars for wings can be built of laminated sections bonded together with cycleweld. As the spars approach the end of the wing, fewer and fewer laminations need be used. Such a design would be considerably lighter than the present ones.

When planes are designed with the new technique in mind, much thinner sections can be used in many places. Today any imperfections in spot welding or riveting are compensated for by making the section heavier. Because the cycleweld bond is stronger, lighter sections will be feasible. It is thought possible to design and build a fighter using considerable plywood, bonding metal to metal and wood to metal throughout—as well as wood to wood—that would weigh considerably less than any present-day fighter, one which would be a superior performer and which could be built at lower cost and in less time.

One of the cycleweld's great advantages, it is said, is that it is the lightest and strongest method of attaching wood to metal. Flooring made of corrugated metal and wood is being produced at the Chrysler plant now. Saunders visualizes the day when we will be making entire airplanes of subassemblies in which most of the joining will have been accomplished by cycleweld and the larger subassemblies bolted or riveted together in the conventional manner.

No clear statement can be made on the saving of time by the use of this process. Generally speaking, it is faster than riveting. On smaller subassemblies spot welding is probably faster than cyclewelding, since the

(*Continued on page* 186)



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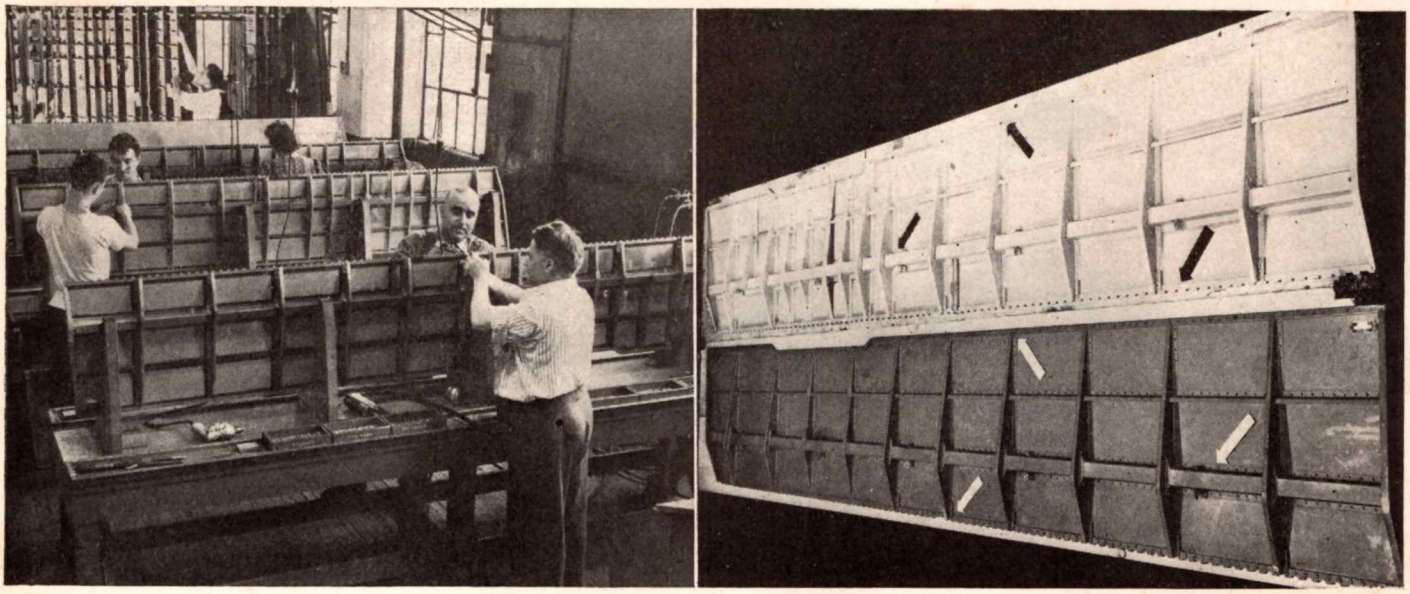


Left: Some riveting is necessary for parts not originally designed for cyclewelding. These rivets are being put in at ends of ribs. Right: At bottom is riveted wing flap while at top is a cyclewelded flap. Arrows indicate places where riveting has been eliminated

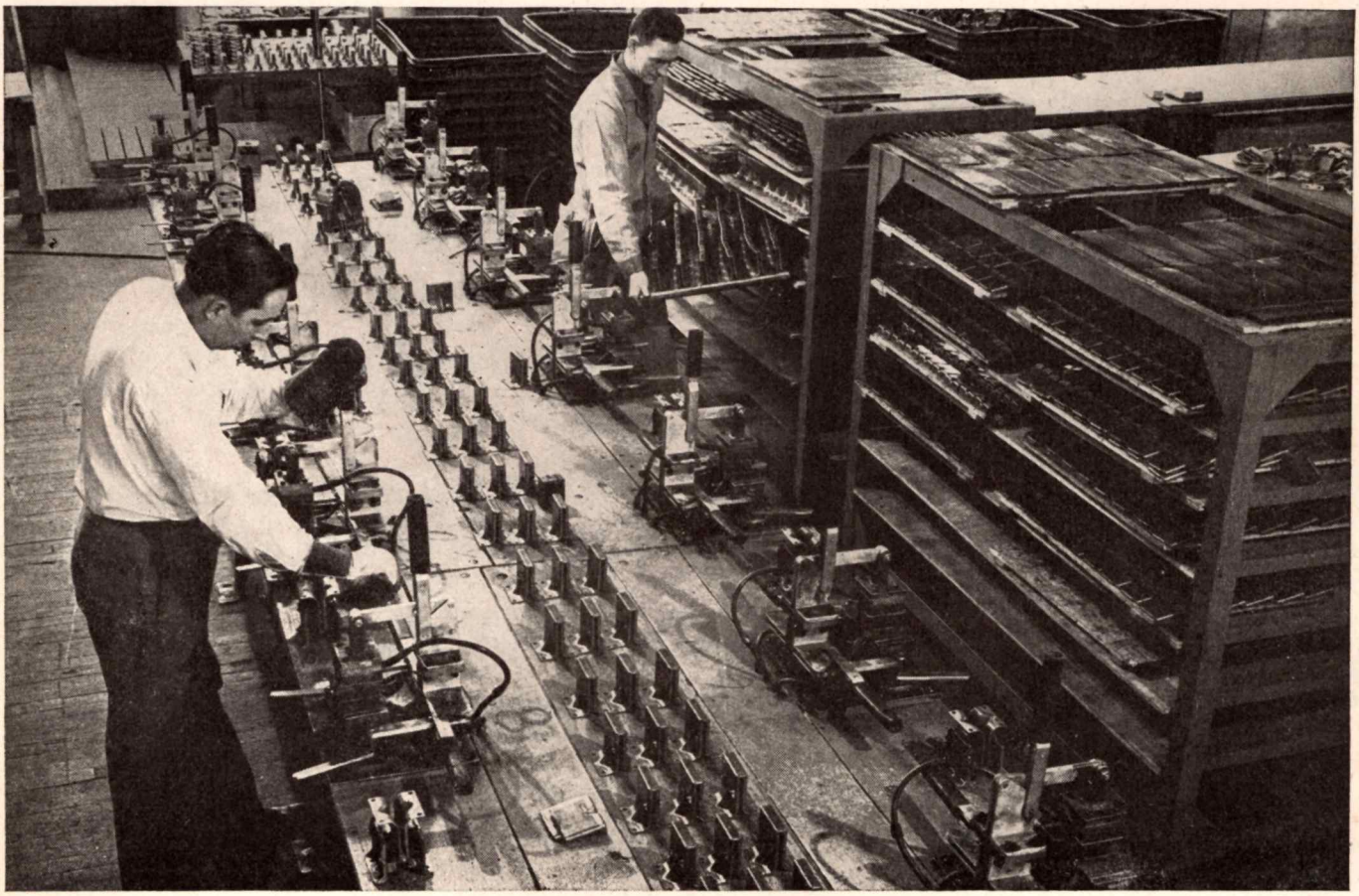
(*Continued from page* 184)
cyclewelded part must remain in the press or fixture for a specified time while the bond is being completed. However, as the subassemblies grow larger and require greater numbers of spot welds, the time advantage of spot welding diminishes.

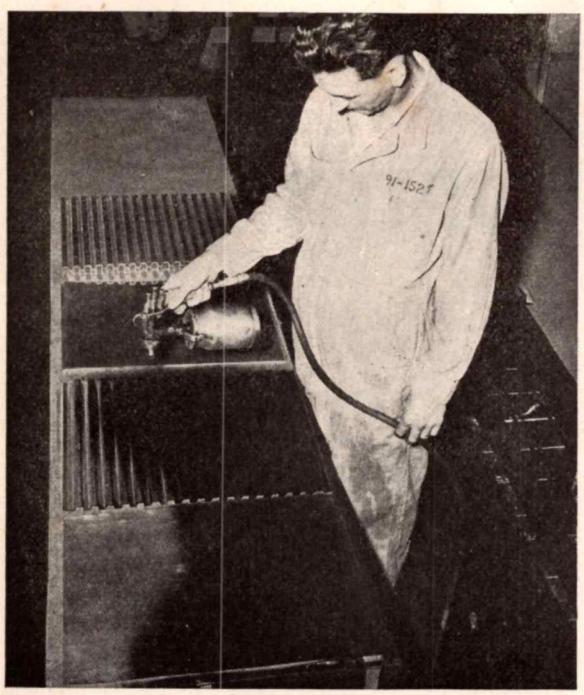
Perhaps the chief advantages of cyclewelding are the increased strength and rigidity, the saving in weight and in production time—over riveting.

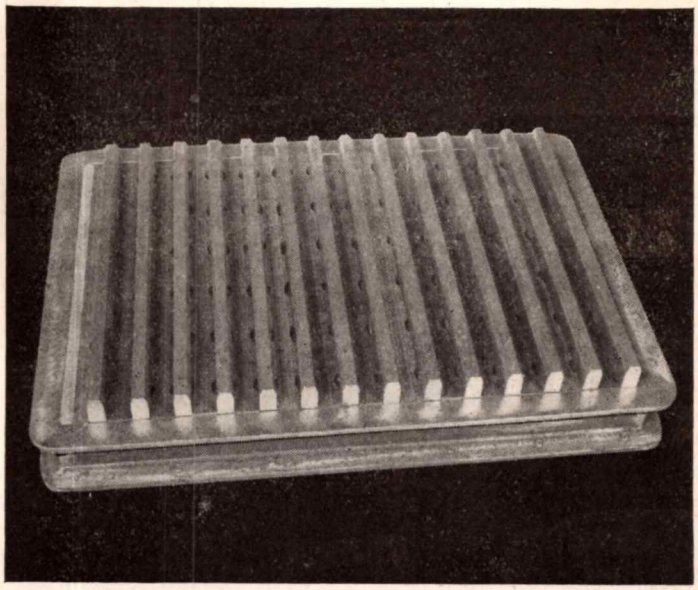
The process finds many special applications in which its superiority is unquestioned. In assembling the glider ski pedestal cycleweld bonds the rubber to the metal. The result is a superior pedestal that will withstand the shock of a fully loaded troop-carrying glider coming to a landing. For this job a cement of somewhat different composition is used than that employed for joining metal to metal or metal to wood.

As a joiner of metal and rubber, cycleweld can be used to seal sheet rubber around the pressure cabins of high altitude ships. It is used to join small metal brackets or parts to a wood surface, or to join large areas

In the case of ski pedestals Buna S rubber is cemented to steel in a toggle clamp fixture containing a cartridge heater







Left: Cycleweld cement is applied to metal sheet and corrugated sections to form airplane flooring. Above: Flooring fits into die for pressing operation to bond corrugated section to flat sheet

of wood and metal as in the case of bomber flooring, with excellent results. It is a satisfactory method for joining the halves of vulcanized fibre jettison gasoline tanks. The cycleweld bond in this case is unaffected by gasoline.

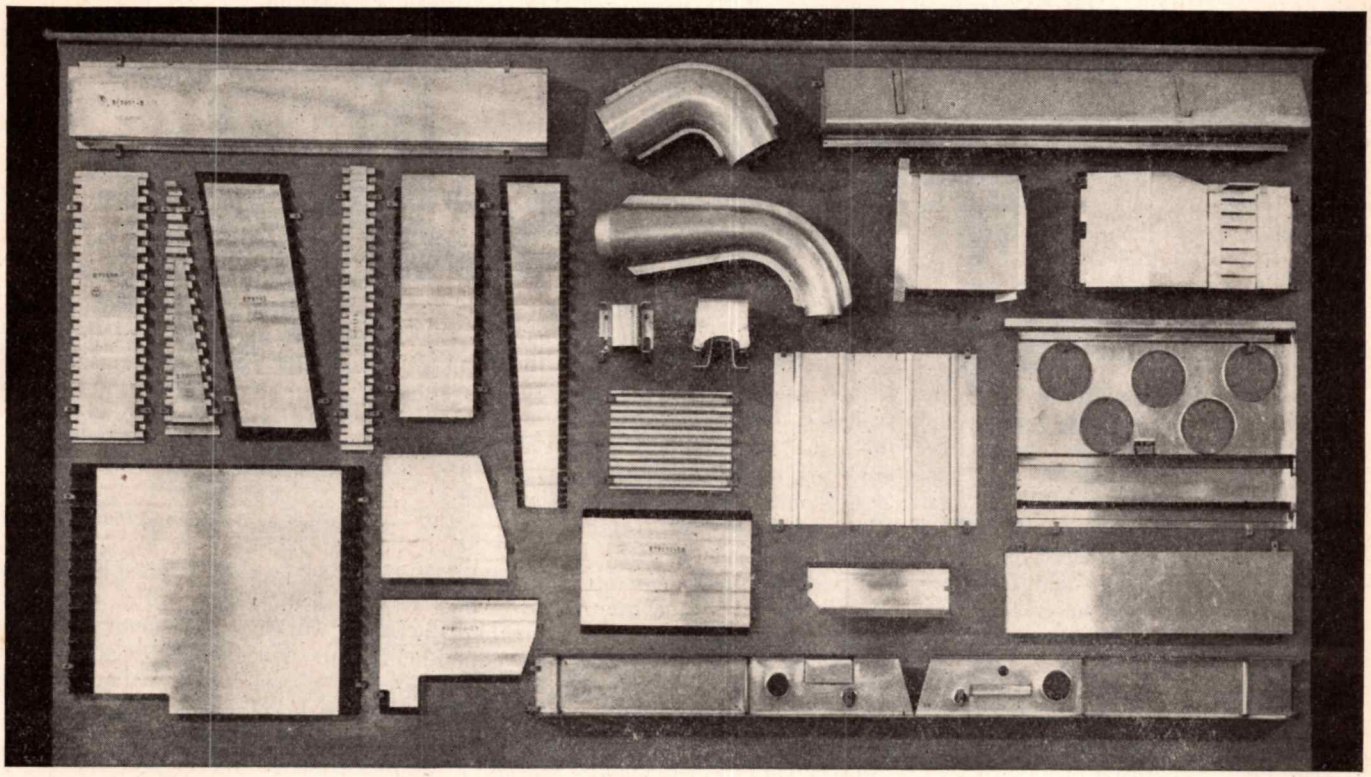
Cycleweld satisfactorily joins two plastic surfaces together, as well as rubber to ceramics, and plastics to wood. All tests so far have shown it to be a versatile technique, certain to have increasing applications to aircraft manufacture.

The full story of the new process antedates this war by several years. It was first used as early as 1938, to attach interior insulation material to car roofs. Two years later the cement was so improved that cycleweld bonds were used to hold together many passenger car parts, including such items as panes of glass, trunk covers, cowling ventilators and fender parts.

In 1941, months before we entered the war, Chrysler contacted the AAF at Wright Field, and together they began experiments in the use of cycleweld for aircraft manufacture. As a result of this cooperation the strength of cyclewelded joints was increased more than 100%, thus assuring its future in the manufacture of airframes. More recently, the strength of the cement has been further increased.

Cycleweld was first described to representatives of the aircraft industry in October, 1942. At that time no information was released on the process, and even today production details and the composition of the cement are restricted information.

Several examples of successfully cyclewelded airplane parts



THE PV-2 HELICOPTER

The PV-2 helicopter, piloted by Frank N. Piasecki, one of its co-designers, in demonstration flight before group of Government officials at the Washington National Airport

● A helicopter designed, engineered and manufactured by the P-V Engineering Forum of Philadelphia, the second built and successfully flown in this country, was demonstrated recently at the Washington National Airport.

Successful Demonstration

Frank N. Piasecki, president of P-V Engineering, made a number of demonstration flights during which the aircraft rose vertically, hovered a few feet off the ground, climbed higher, and turned in its own length. He then flew forward at a good speed, backed up, flew sideways and descended vertically to hover again and pose for pictures a few feet off the ground.

Piasecki test flew and learned to fly this helicopter simultaneously—a remarkable feat for both pilot and plane. The machine, conceived over two years ago, has been flying since March, 1943.

The PV-2, according to its sponsors, boasts a simplified and highly effective control system. Not only can translation be obtained in any direction by moving the control stick in that direction, but the machine can also be tilted or rolled on its own axis without any translation.

It is a relatively small aircraft built primarily to prove the aerodynamical, mechanical and engineering theories of the engineers who worked on the machine. The original conception was to make the smallest, simplest and most practical helicopter yet built, but at the same time to develop the most advanced helicopter design.

The three blade rotor has a 25-ft dia with a tip speed of approximately 350 mph. The machine utilizes in general the torque reaction method developed by Von Baumhauer—a main rotor with a small auxiliary rotor approximately one-fifth the dia of the main one, in a vertical plane at the after end of the fuselage.

With a gross weight of 1000 lb, including the pilot, plus two hours' fuel, it will develop 95 mph forward, yet can land in a clearing only 50 ft in dia. Its landing speed is zero; it can cruise at 85 mph and back up at 20 mph. The PV-2 is powered by a 90 hp 4-cylinder, air-cooled engine.

According to Elliot Daland, vice-president and chief engineer of P-V, the firm has ready for production a helicopter with a payload of over a ton—8 to 10 passengers plus baggage —and a range of about 400 miles.

Designed by Daland and Piasecki

The PV-2 was co-designed by Daland and Piasecki. The latter has been actively working with autogiros and helicopters since the advent of the wingless gyros, while Daland is one of the early pioneers of the aircraft industry, having been with Standard Aircraft during World War I.

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In addition, there are other advantages to the use of American Phillips Screws which come from the name American: Full Value, guaranteed by self-checking count and individual inspection. American Engineering, that gives you expert help on special fastening problems. And American Service, that gives reasonably prompt delivery even in war time.

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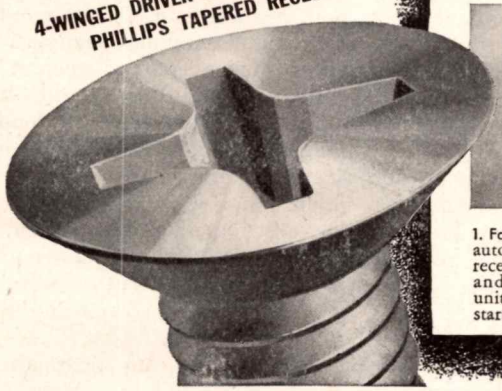
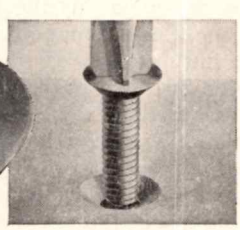


4-WINGED DRIVER CAN'T SLIP OUT OF PHILLIPS TAPERED RECESS



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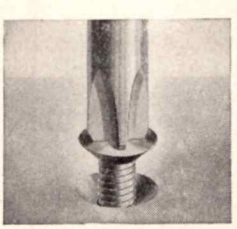
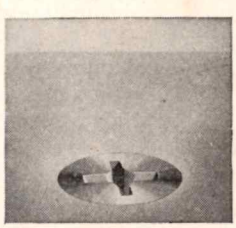


2. Faster Driving—Spiral and power driving are made practical. Driver won't slip out of recess to injure workers or spoil material. (Average time saving is 50%.)



3. Better Fastenings—Screws are set up uniformly tight, without burring or breaking heads. A stronger, neater job results and there are no gouges on work-surface.

Use of WOOD in Aircraft Design and Construction - PART I*

J. J. WALLACE
Ass't Chief Engineer, General Aircraft Corp.

● Despite many well-stated opinions regarding the satisfactory nature of all-metal structures, it became necessary during this war to find materials for aircraft manufacture that would supplement our supplies of other materials so that we could utilize our talents to the maximum in designing and building planes. This is where wood entered the picture and this is why wood will stay in, at least until the present war is over.

If the use of wood were suddenly to be discontinued a valuable contribution to the art of aircraft design and manufacture would be stillborn. Most engineers who have had experience with it will admit many defects but will maintain that in the proper place and in the proper form wood is unsurpassed by other materials in efficiency and utility. At the present time the only limitations that can fairly be placed on the use of wood are placed there by our lack of complete and detailed information on its behavior.

Plastic and Resin Adhesives

During the early 1930's new types of glue developed by some of the leading plywood companies in this country and England brought about increased use of plywood in aircraft. These new glues had many improvements to offer over previous casein, animal and vegetable glues in respect of permanence, weather resistance, fungus-growth resistance and adaptability to high production. These are the so-called "plastic" and "resin" adhesives of today.

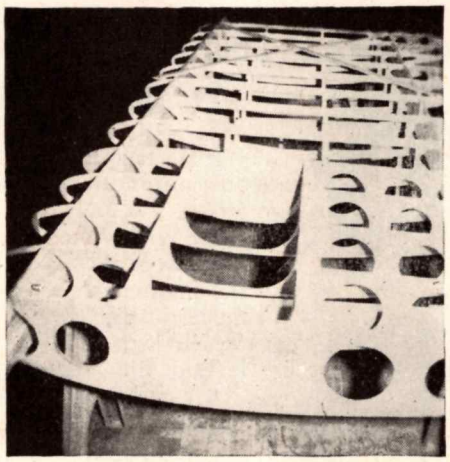
Along with the development of these glues, many new designs in wood, dubbed plastic, were brought out. Manufactured by the bending of flat plywood were the wings of the Howard DGA 15, the Cessna monoplane and the wings and fuselage of the Culver *Cadet*. This process of bending flat plywood was used to some degree on many airplanes and to a large degree on a great many others.

At a slower rate of development, designs making use of the new bag-molding processes were gradually brought out. Such airplanes as the Summit and many experimental wing panels, tail surfaces and fuselages were tried. The success of such developments has been comparable to and in some cases greater than that of the flat plywood designs, although far fewer successful articles have been produced by the bag-molding process.

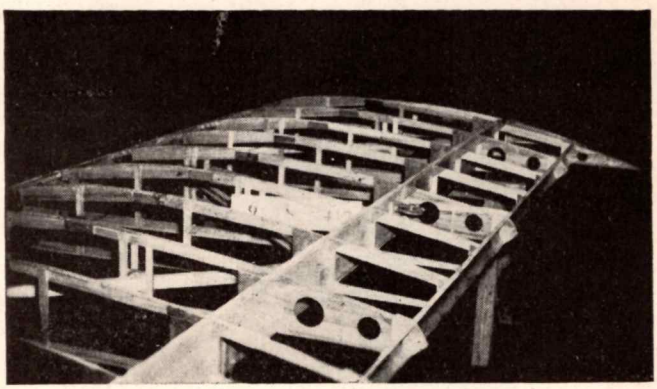
Information on the basic physical properties of wood and plywood is available in many widely read publications and will not be dealt with extensively here. However, a careful examination of this data with an eye to specific design comparisons with other materials will convince the engineer that wood in general is an efficient structural material, especially when it comes to columns.

The durability of wood in structural applications is a highly controversial question. Much evidence is available both pro and con. On the one hand we have many examples such as telephone poles, fence posts, ancient houses still standing, 100-year-old ships still afloat and ten-year-old wooden airplanes still carrying NC licenses and engaging in regular operation. On the other hand we have rotting wharves, the splitting of and structural failures in wooden furniture normally used in the home, as well as several striking examples of structural failures of wood aircraft in flight.

The evidence may be weighed as the



Two spar wood wing: gas tank space in foreground



Right: Same wing as above, showing aileron hinge fittings and wood drag truss

* The concluding instalment, Part II, will appear in December.—Ed.

individual engineer sees fit. We are really more interested in the reliability of a material over a specified period than its ability to withstand the passage of time indefinitely. It appears that with the exercise of proper care we might manufacture wooden airplanes which, from this standpoint, would be as satisfactory as airplanes manufactured from any other material.

Plywood Inefficient except in Shear

An examination of the physical properties of plywood, however, leads to the conclusion that ordinary aircraft plywood is quite inefficient as a structural material—except in shear. Plywood is normally constructed so that the sum of the thicknesses of the face plies is equal to the thickness of the core ply in three-ply construction; and in higher ply numbers it is constructed so that equal amounts of material are laid at 90° to each other. This immediately reduces the tensile or compression strength in any given direction by a very large percentage.

Research work on plywood indicates that the resin film between laminations and the stabilizing effect of the cross plies allow the plies lying parallel to the direction of load to develop a higher ultimate strength than they would normally develop as solid wood. However, the weight added by the resin film between each ply again reduces the efficiency of the material so far as these properties are concerned.

The use made of plywood by early designers was such that the best property of the material, namely, its high shear strength, was exploited to full advantage while its strength in other directions was neglected. The Fokker, Lockheed and many British designs are examples of this. Many modern designers of wood structures have also consciously or unconsciously followed this philosophy of design. However, many others have found it advantageous to line up the face grains of skins so that the skin absorbs an appreciable amount of the beam tension and compression with only a slight reduction in the shear strength. This technique probably results in a higher structural efficiency in some applications but has resulted also in many ignoble failures of wood structures under static tests, due to the effect of combined shear and tension.

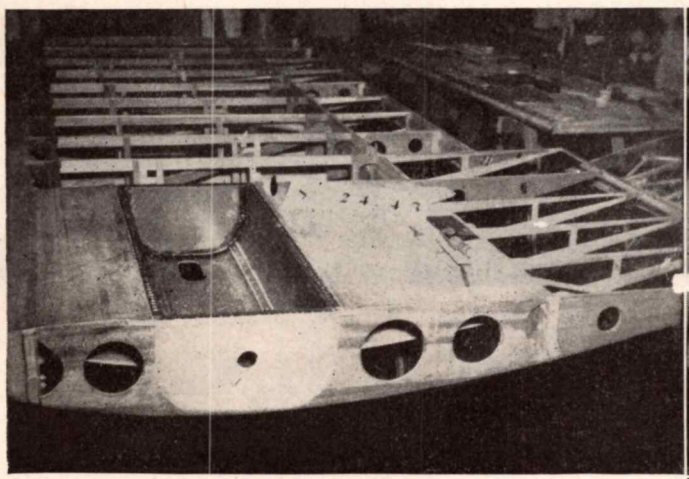
The analysis of the strength of plywood under such loadings is extremely difficult in the present state of the art. Certainly the more conservative method of design is to align the plywood in such a fashion that it takes only one type of load and presents a low modulus of elasticity to all other loads imposed upon it. This technique usually results in the use of so-called 45° skin on wings, fuselages and so on.

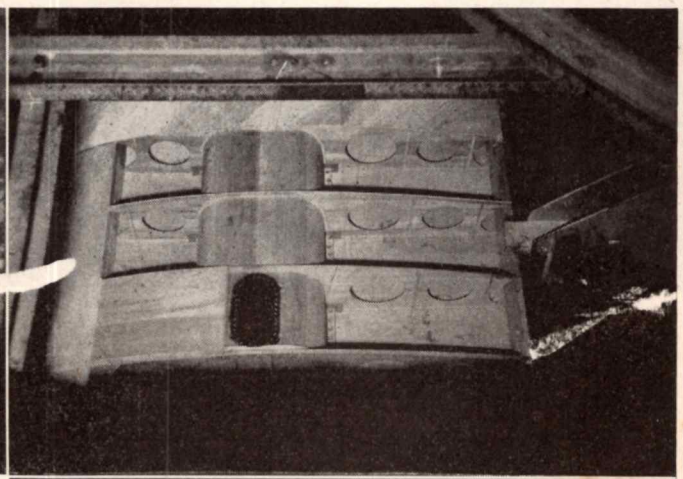
The dimensional stability of plywood is far better than that of solid wood perpendicular to the grain; otherwise no appreciable difference exists. Most users of plywood will acknowledge, nevertheless, that a great deal of trouble is encountered in the warping and buckling of external skins under varying weather conditions unless very heavy skins are used and extremely close manufacturing control is imposed over shop conditions.

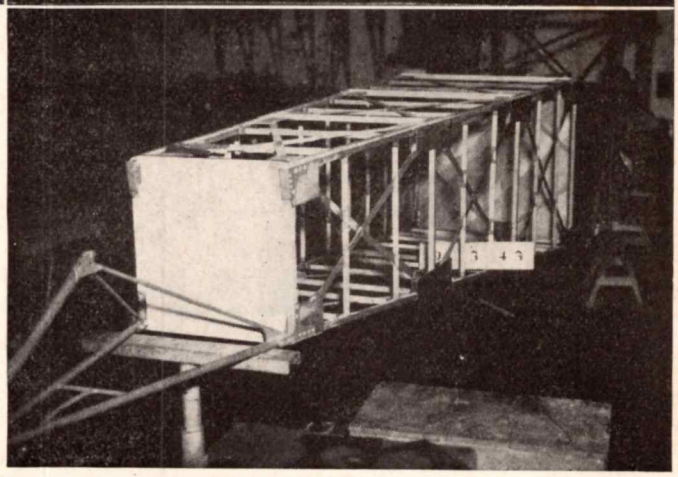
Preliminary Investigation

The writer ventures to suggest that before an engineer begins the design of a wood airplane the following investigations be made: (1) a study of all the wood airplanes upon which detailed technical data are available; (2) as complete a study as possible of the

(*Continued on page* 284)







Above: Plastic-lined plywood gas tank installation

Above, right: Plywood tank installation, top view

Right: Wood tension truss, rear fuselage section

Ships that Fly Themselves!

ONE REASON for America's highly successful precision bombing is the Automatic Pilot, developed and manufactured by Minneapolis-Honeywell. Until recently, details of this super-sensitive electronically controlled instrument were secret, but it can now be said that the M-H Automatic Pilot not only accurately directs the ship, but on bombing runs actually holds the plane on a designated course over the target, providing a stable platform from which bombs are released.

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AERONAUTICAL INSTRUMENTS

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Frigid Blasts Near Sound Speed to Test Tomorrow's Planes

NEIL E. HOPKINS
Application Engineer, York Corp.

IT is the purpose of the new wind tunnel at Wright Field to permit testing conditions quite beyond the limits of present tunnels in this country, with air velocities approaching the speed of sound and air temperatures and pressures equivalent to altitudes up to 50,000 ft.

The shape and arrangement of the tunnel is shown in fig. 1. The tunnel is completely enclosed, and has an air passage approximately 600 ft long. The tunnel cross section is circular throughout, and it will be noted that the cross section varies in area around the tunnel. At the throat, the air velocity is at a maximum. Here, in order to simulate altitudes up to 50,000 ft, it is necessary to obtain temperatures as low as —67°F, and pressures as low as 1.69 lb psi absolute. It is at this point that air velocities approaching the speed of sound are obtained.

Air Circulating System

Air will be circulated by means of two counter-rotating axial flow fan systems in turn driven by two 20,000 hp fan motors. Speed variation in these motors will be obtained by use of variable speed wound rotor type induction motors, with two sets of auxiliary a-c, d-c, motor generator sets for the return of power from the main rotors to the a-c supply system.

Two features relative to the dynamics of air flow in this tunnel are of interest. First, the kinetic energy of the airstream at the throat section is considerably greater than the energy imparted by the fans. Second, there is an air temperature drop between the large diameter section and the throat section. At 600 mph throat velocity, this temperature drop is 60°F.

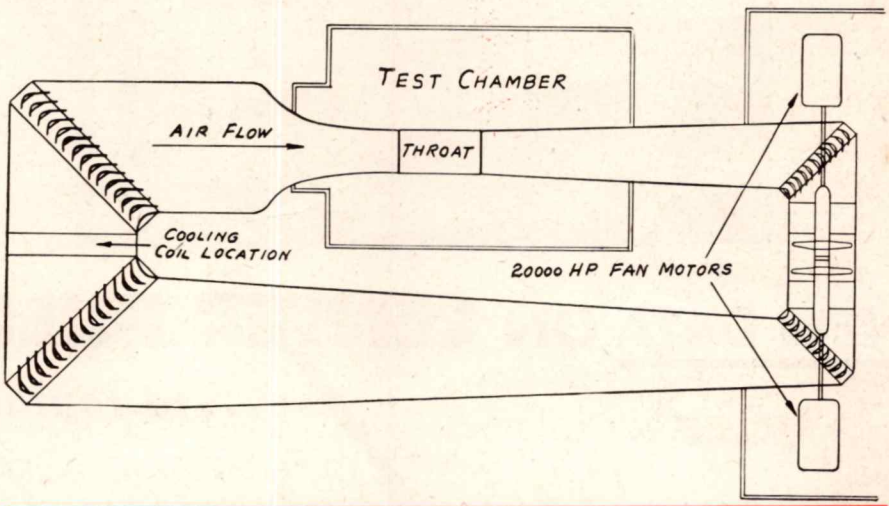
The main reason for these two phenomena is the fact that kinetic energy at the throat has been established at the expense of potential, pressure or energy. Thus with maximum air velocity at the throat there is a corresponding minimum static pressure. It is this reduction in pressure which brings about the adiabatic reduction in temperature in accordance with the formula

$$T_2 = T_1 \left(\frac{P_2}{P_1}\right)^{.286}$$

where T and P refer to temperature and pressure on the absolute scale.

Some idea of the size of the tunnel

(*Continued on page* 195)



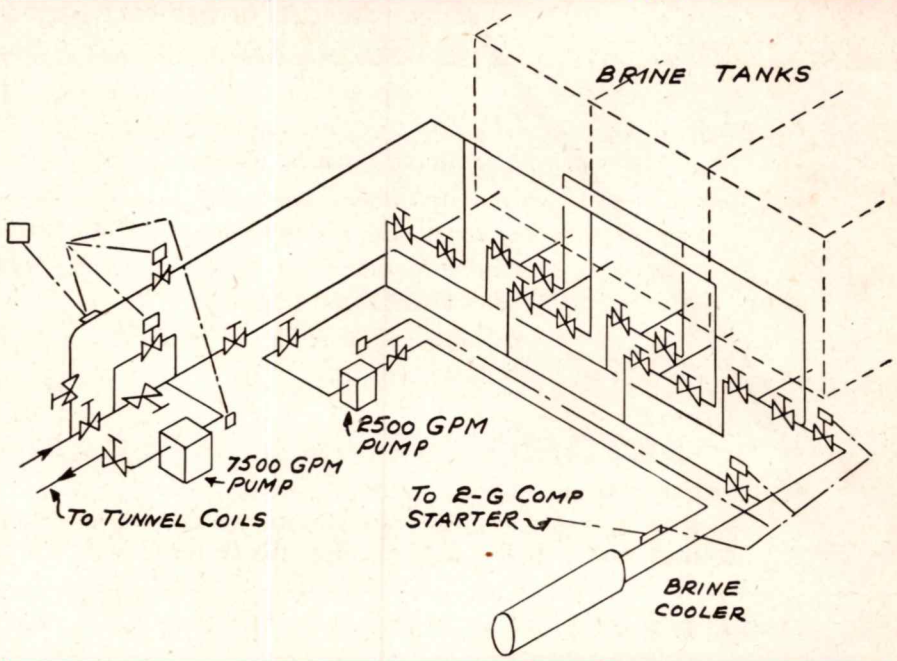
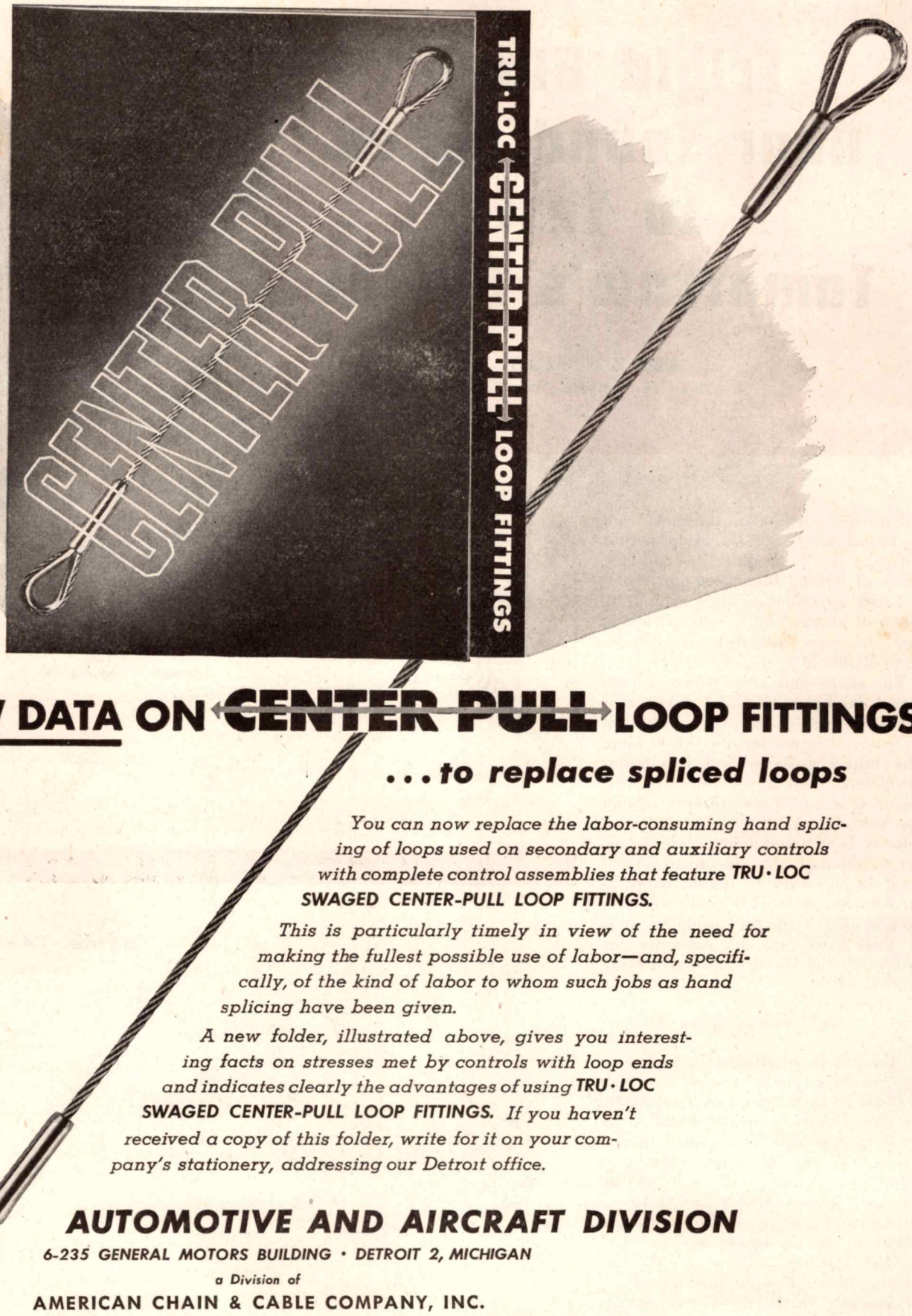


Fig. 1, above: Shape and arrangement of the wind tunnel at Wright Field. Fig. 2, below: Isometric sketch of brine piping system



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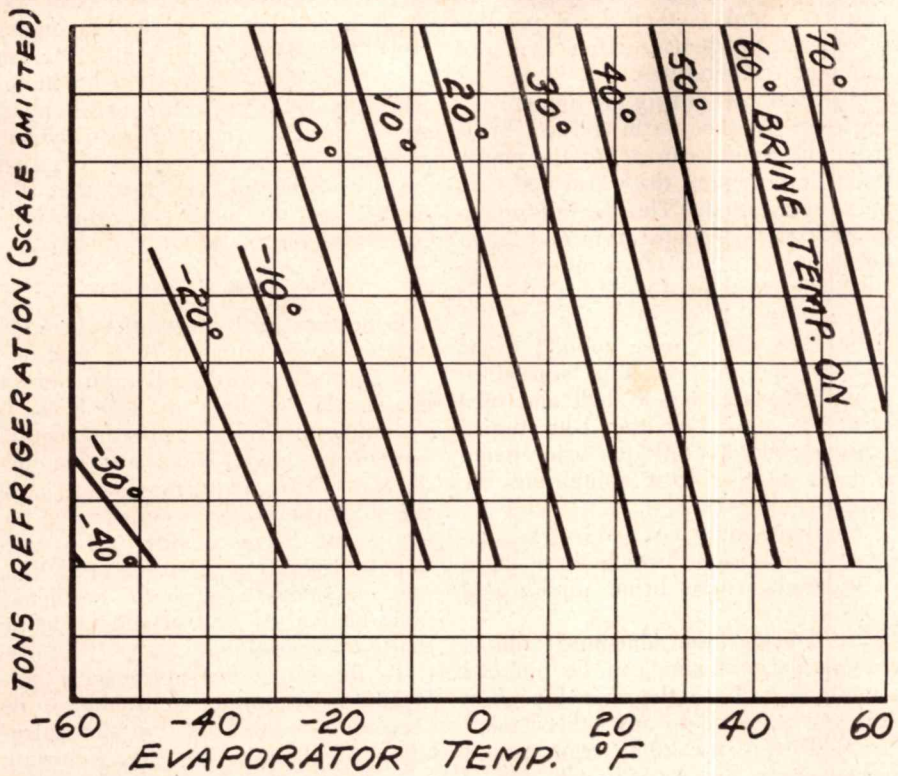


Fig. 3: Brine cooler performance chart

(*Continued from page* 193)

can be gained by the fact that in the evacuation process to simulate high altitude conditions, 20,000 lb of air must be removed by the vacuum pumps. The quantity of air circulated by the fans is several million cfm, and an air resistance of 2 in water gage anywhere in the air circuit adds well over 1000 hp to the fan load.

The foregoing has been by way of description of the tunnel as a whole. We are chiefly concerned here with the question of cooling the air. The capacity of the refrigeration equipment involved and the nature of some of the problems encountered make the air cooling question one of major importance.

Cooling Load during Operation

During the operating period the cooling load is as high as 8000 tons, mainly due to the heat put in by the fans. Since a temperature as low as —67°F at the tunnel throat is required, it can be seen that the refrigerating equipment must operate at fairly low evaporator temperatures.

Actually, the high tonnage condition of operation does not occur simultaneously with the low throat temperature. Furthermore, the temperature variation around the tunnel due to adiabatic expansion and compression of the air in its flow, makes it possible to obtain air that is considerably colder at the throat than that leaving the air-cooling surface. By locating the surface in that part of the tunnel having the largest diameter, not only is the minimum coil air resistance obtained but the air temperature difference between the coil and the tunnel throat becomes a maximum. Hence it is not necessary in this tunnel to cool the air below —7°F leaving the cooling surface.

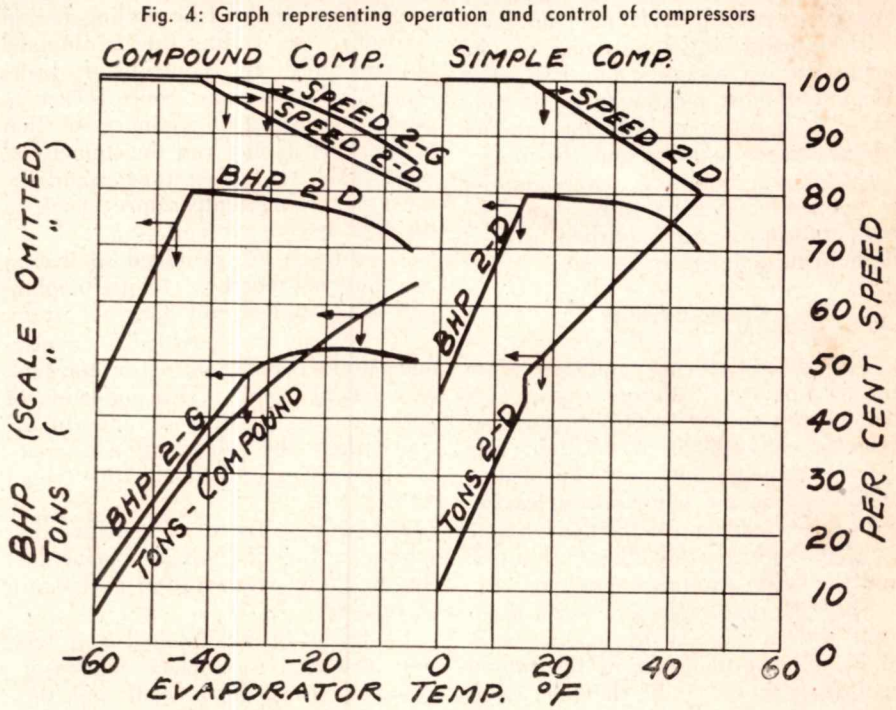
As the coil air pressure drop is limited to a relatively low figure, the design and development of the heat transfer surface was a major problem. At 2500 fpm air velocity at the coil surface a pressure drop of 2.6 in of water is allowable at an air density exceeding that at normal atmospheric pressure. This limitation in pressure drop plays an important part in the design of the cooling coil, inasmuch as the usual or standard coil design would set up air resistance equivalent to 15 in of water pressure.

Steel Preferred to Copper

About 300,000 sq ft of heat transfer surface will be used in cooling the air. The material used will be steel, which has several advantages compared to copper. Not only is the steel easier to obtain but its greater structural strength permits greater length of individual coils, making for a better coil assembly. There is another reason why steel is preferred for the coil material. Calcium chloride brine will be used as the cooling medium in the tunnel, in which case steel is preferable to copper from the corrosion standpoint.

Brine is used as a cooling medium so as to take advantage of intermittent tunnel operation in the use of a

Fig. 4: Graph representing operation and control of compressors



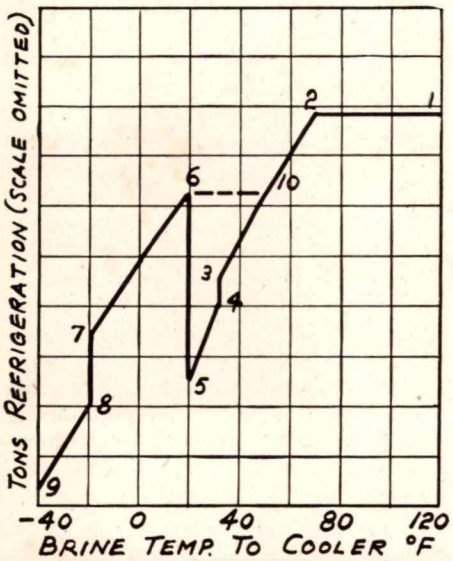


Fig. 5: Capacity plotted against brine temperature

storage system. A 1-hr tunnel operating period is followed by a 20-hr tunnel shutdown period, which makes a storage system attractive from the standpoint of reduction in refrigerating equipment capacity. With a storage system an 8000-ton tunnel cooling load, active for one hour, can be carried by refrigeration equipment rating 400 tons average capacity, neglecting losses, active for 20 hr.

In the calculation of brine storage capacity, it was necessary to consider all possible conditions of operation. While the 8000-ton load condition represents the greatest heat removal, namely 96,000,000 Btu for the one-hour operating period, it is not the most critical from the standpoint of the brine storage quantity required. The amount of heat picked up by storage brine is in direct ratio to the product of the brine quantity and the range. The 8000-ton condition, corresponding to sea level operation with normal air temperature, is accomplished with a high brine temperature range.

Critical Condition

The most critical condition from the viewpoint of storage capacity is that corresponding to 600 mph throat velocity, at 40,000 ft altitude and —67°F throat temperature. For at this condition the air temperature leaving the cooling coil is —7°F, the tonnage is 2110, the brine range is a minimum, and the brine storage a maximum.

Three storage tanks are to be used, each with a capaciy of 12,000 cu ft of brine. At the start of the tunnel cooling period, two of the tanks will be filled with —40°F brine. The third will be empty. The purpose of one extra tank is to make it possible to operate without mixing brine of different temperatures.

For example, during the tunnel cooling period, the warm return brine from the tunnel can go to the empty tank, thus keeping the warm and cold brine segregated. This permits maximum economy of operation and facilitates control of air temperatures. An isometric sketch of brine piping is shown in fig. 2.

For the 20-hr brine cooling cycle, a 2500 gpm brine pump is used in a circuit containing a shell and tube brine cooler. For the 1-hr tunnel cooling cycle, a 7500 gpm brine pump is used in a circuit containing the tunnel cooling coils.

Mention should be made of a number of provisions which have been considered in the brine piping and controls.

(1) During the one-hour tunnel cooling period brine can be pumped from any tank to the tunnel cooling coil and returned to any other tank.

(2) During the 20-hr regeneration period, warm brine can be taken from any one of the three tanks, circulated through the brine cooler and returned to the same or any other tank.

(3) Automatic controls are arranged so that during the regeneration period the brine going to the brine cooler can be kept below a certain maximum temperature, thus preventing overload on the compressor motors and preventing excessive strains in the cooler tubes.

(4) During the 1-hr cooling period control of the cooling rate is obtained automatically by control of brine valves. These same controls act to modify temperature changes so that at the start of any run the tunnel coil is brought to temperature gradually, thus preventing temperature shock to the heat exchanger coil.

(5) Means are provided so that at the end of the 1-hr tunnel cooling period the tunnel coil does not drain.

(6) Means are provided for continuous tunnel operation, using one tank as a balance tank. This condition of operation is possible at low tunnel loads where the refrigeration capacity of the system can handle the tunnel load.

The main items of refrigerating equipment for the cooling of brine during the 20-hr regeneration period are as follows:

1—46 in × 12 ft shell and tube extruded fin surface condenser
1—84 in × 16 ft shell and tube brine cooler with 1-¼ in od tubes
1—2-D centrifugal compressor for high stage, with 1250 hp motor
1—2-G centrifugal compressor for low stage, with 1000 hp motor

The balance of the equipment's capacity against the cooling requirement, to determine the cooling time is rather involved due to the fact that the cooling of the mass of brine is a batch process.

Wide Range of Conditions

Conditions are constantly changing as the brine temperature is reduced, and since the brine temperature range involved is as high as 140°F, it is necessary that the refrigerating equipment operate under widely varying conditions. This requires that a careful study be made to determine the equipment balance under all conditions of operation, in order to obviate possible motor overload, to determine method of control and to define limits of operation.

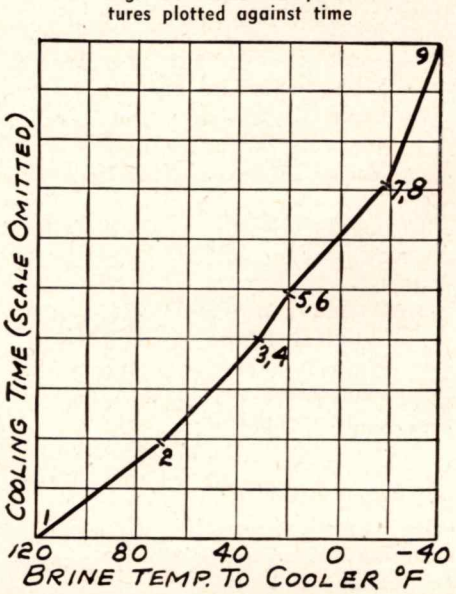
To determine the equipment's performance, from the standpoint of its protection as well as for the calculation of cooling time, the following procedure was adopted.

The capacity of the brine cooler was plotted as shown in fig. 3, with evaporator temperature plotted against tons of refrigeration for various brine temperatures to the cooler. In establishing this curve, consideration was given to the fact that the brine quantity varies from 2200 gpm at —40°F, to 2800 gpm at 80°F brine temperature.

The centrifugal condensing system capacity and brake hp was established

(*Continued on page* 294)

Fig. 6: Brine temperatures plotted against time



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AIRCRAFT POWERPLANT CONTROL SYSTEMS

NORMAN N. RUBIN

● Backlash, or loss of motion in the control run, is the prime potential trouble with all engine control systems. Backlash may be detrimental to the accuracy with which a control can be set; it may make it impossible to achieve a full throw of the control; through looseness and vibration it produces wear. Considerations involved in designing a backlash-proof system include: the sum of the frictions in a system; clearances in the various joints; the force required to move the control; flexibility of the components in a system, and the possibility of change in length of the control run. The latter may be caused by mechanical stretching of cables in the system, by expansion or contraction due to extremes of external temperature, and by flexure of the structure to which components of the control system are attached.

Friction finds itself in an anomalous position. While it is desirable to reduce friction to a minimum, on the other hand, a totally frictionless control system would not be practical, because it would be free to vibrate in all its parts, wear its clearances larger and thereby increase backlash. Without the restraining and damping effect of friction a control placed at a given adjustment would be jiggled out of position in short order. In practice, friction is kept as low as possible for such items as pulleys, bellcranks, jackshafts, and fairleads by use of ball or roller bearings, but damping friction is applied at cockpit controls, and may be either constant or adjustable at the control. Some cockpit controls contain definite stops, as do some of the accessories which they operate. Friction forces must, therefore, be set at an optimum figure—a compromise between control force and vibration. Friction should be such that cockpit control forces are on the order of 1½ to 7½ lbs.

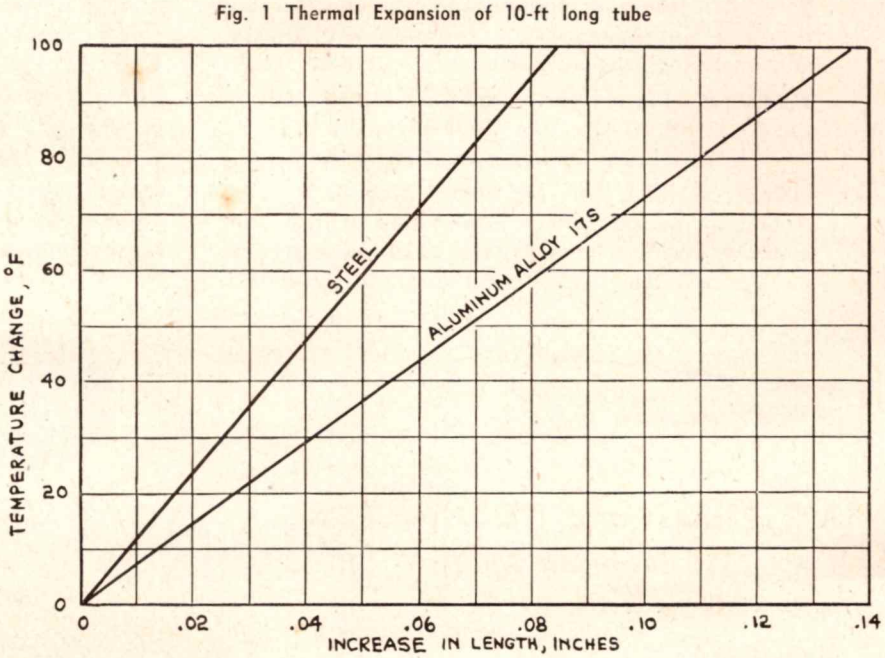
Jackshafts, brackets supporting pulleys and bellcranks, and push-pull tubes or cables, should be of sufficient strength that they will not deflect under operating loads. Long push-pull tubes should not be offset or joggled. Long torsion members should be checked for deflection. Cables should be, and generally are, prestretched, and the military and civil authorities both specify certain minimum diameters of cable which may be used. Stainless steel cables will stretch far more than ordinary steel cables; the use of stainless steel should therefore be avoided unless its non-magnetic and corrosion-resistant properties make its employment mandatory. Flexible control runs should be firmly anchored to structure along their lengths, to keep them from squirming and changing their effective lengths, when operated. Bend radii of the casings of flexible controls should be under constant observance. While these radii are limited by structural considerations for any given type of flexible control, generally with decreasing bend radius, the control will develop prohibitive friction before the structural bend limit is reached.

Temperature Effects

The effect of temperature extremes on control system backlash will cause trouble if not properly designed. Fig. 1 shows graphically the effect of temperature on steel and dural tubes or rods. The coefficient of thermal expansion of chrome-molybdenum steel is about half that of dural. A dural control tube operating in a dural structure will not, in net, be affected by temperature changes, but a dural tube spanning a steel tubular structure, or

(*Continued on page* 204)

Fig. 1 Thermal Expansion of 10-ft long tube



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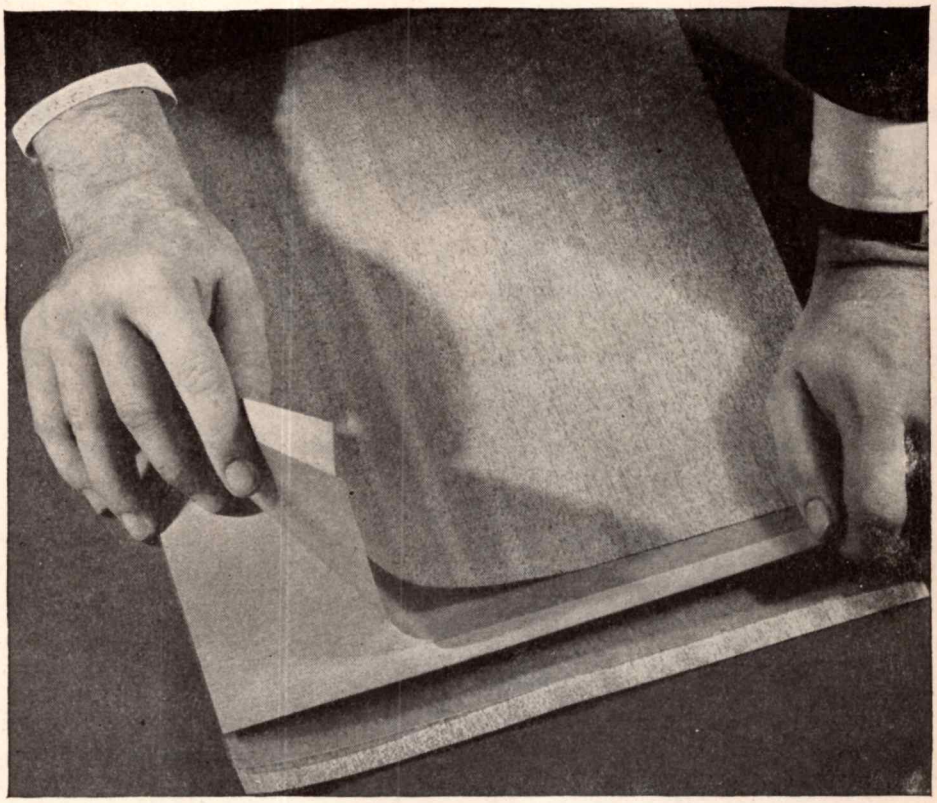

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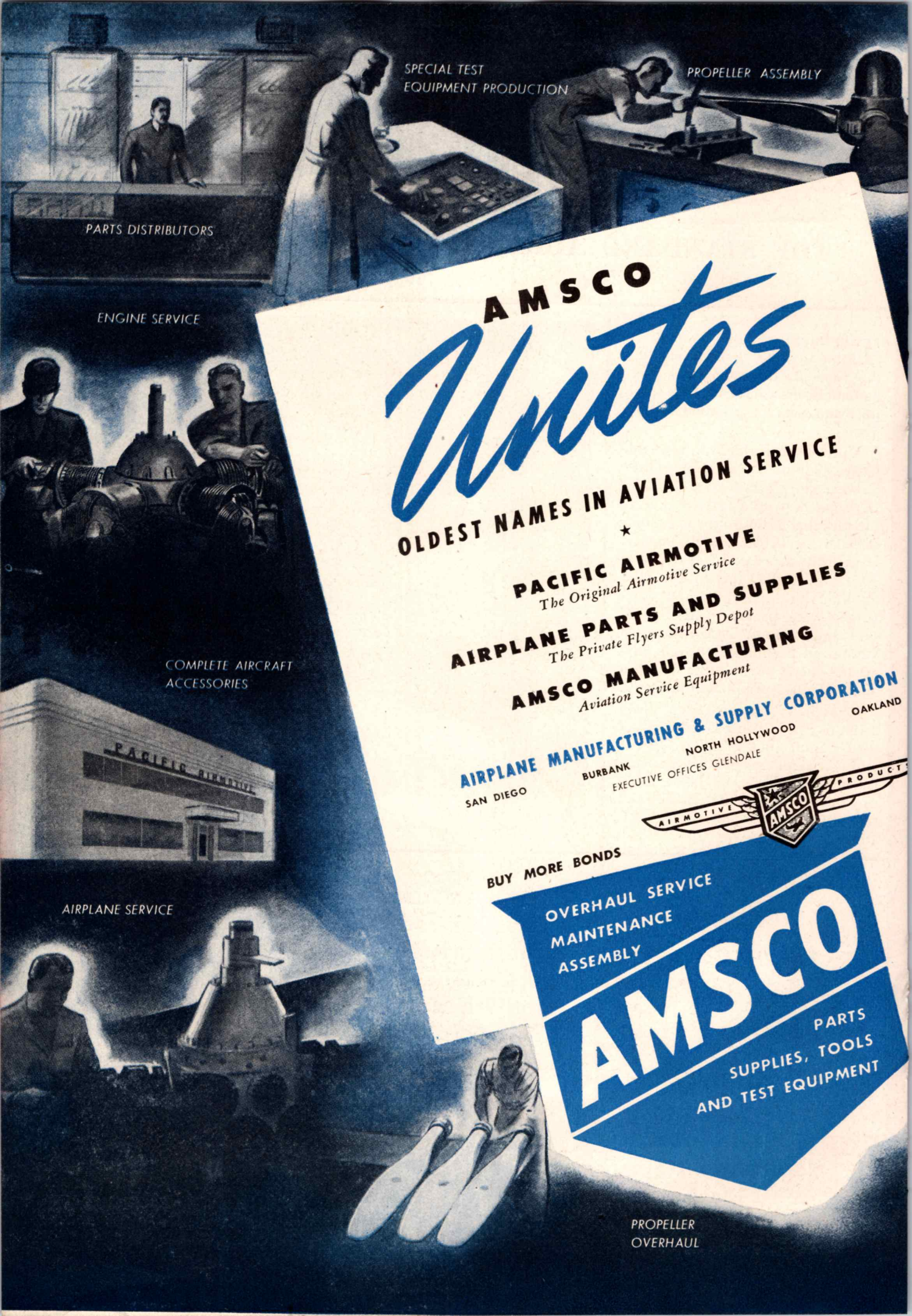

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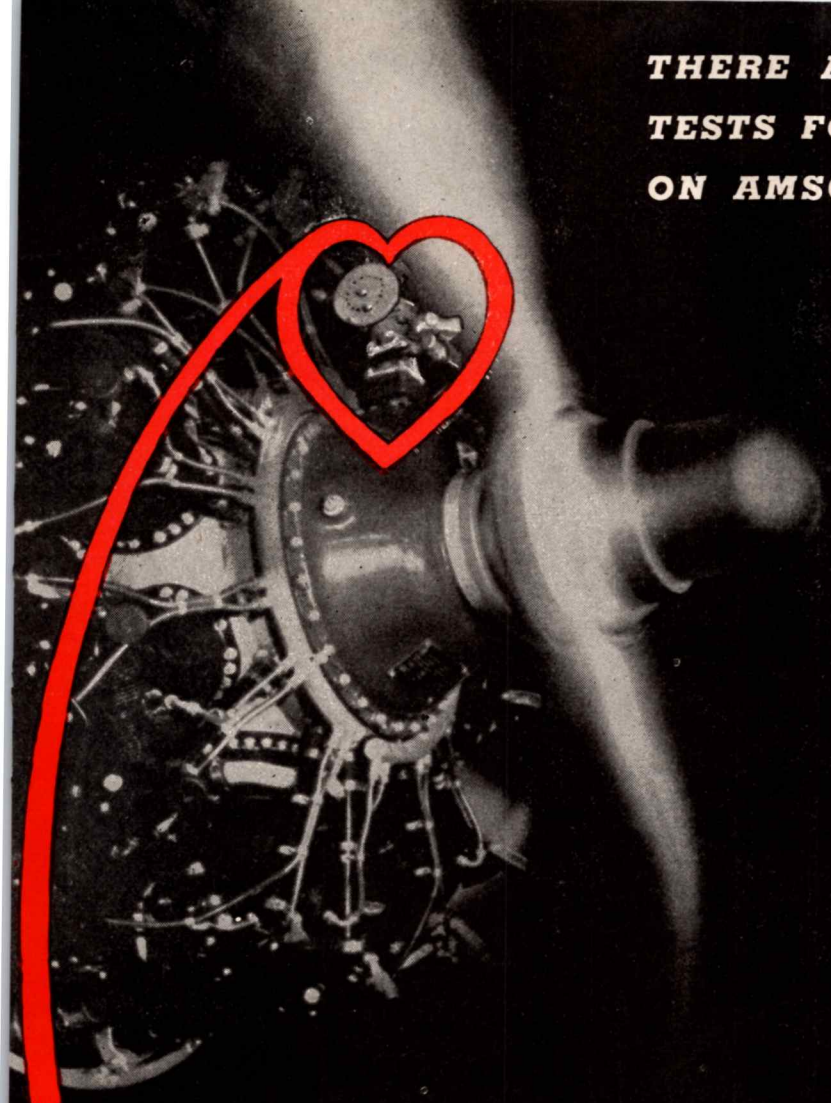

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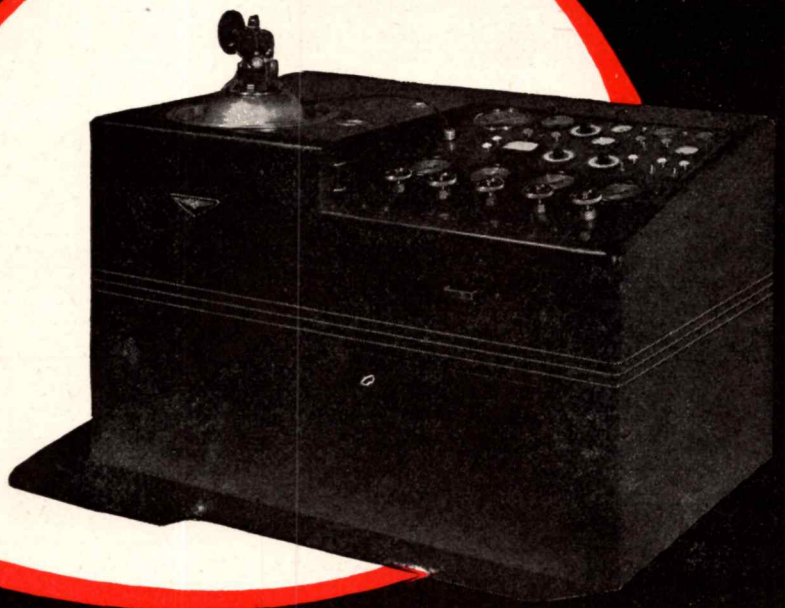

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POWERPLANT CONTROL SYSTEMS

(*Continued from page* 198)

a steel cable in a dural wing structure, will exhibit temperature effects. Steel cables in a dural structure, rigged tight in warm weather, will loosen in the cold of altitude; dural tubes will shrink more than steel structure when cooled and must be adjusted accordingly. Adjustment means, such as threaded rod ends and turnbuckles are generally provided in control systems with which to make these rigging changes. However, temperature effect assumes importance only in long control runs and extreme temperatures.

Flexure of Structure

Flexure of structure, to which controls are fastened, is not generally a serious consideration, except in the case of the outer engines of multi-engined airplanes. Here the controls run along the wing from the fuselage or hull to the engine. The wing bends in flight as it accommodates itself to airloads. If the controls are not in or near the plane of flexure, they will slacken or tauten depending on whether they are on the compression or tension side of the neutral axis. This may be remedied by breaking the control run; that is, by locating half the run above the neutral axis and the other half below, so that the tensile and compressive effects cancel out. However, this requires the introduction of idlers or pulleys, which is undesirable because of increase in weight, additional parts, and additive clearances tending toward backlash.

After designing a system that is as free of backlash as possible, it is customary to allow overtravel at the cockpit controls, as a safety measure. For quadrant type controls 5° to 10° are allowed at each end of the travel, and for push-pull types 1/4 to 3/8 in overtravel is provided at each end of the stroke. These values may be increased for very long control runs having a large number of breaks.

Devices employed to change the direction of a control run, such as cranks, pulleys, and fairleads, constitute a second source of potential trouble in power plant control systems. The importance of close clearances in all moving joints was emphasized in the discussion on backlash, and rigidity of supporting brackets is necessary for the same reason. From the point of view of serviceability several things must be considered. Controls should be easily accessible for inspection, which implies that they should come through near the outer edge of a firewall. They should be grouped as nearly as possible at one spot, and not spread around the circumference of the firewall to form a fence preventing access to the rest of the powerplant installation. Jackshafts and bellcranks should not be hidden under oil tanks or behind generators so as to be inaccessible to maintenance personnel. Easy accessibility and close grouping are especially important when quick-detachable units are used in control runs.

Available shop equipment may be a consideration in the selection of design for crank systems—bellcranks, idlers, jackshafts, and their supports. They can be of welded-up steel tube and sheet; formed and rivetted dural sheets may be used, or parts stamped from heavy dural sheet. Small forgings or castings are practicable. Selection will also be influenced by quantity of production and attendant cost considerations, as well as by the possibility of standardization of parts.

Rigidity in operation is again the controlling factor in the design of the shapes of bellcranks and idlers. Push-pull tubes with forked or clevis ends put the load directly into a lever, with the clevis bolt working in double shear. The forked rod end has the disadvantage of fairly high friction, with the attendant possibility of wear. While ball bearing rod ends have low friction and are self-aligning within 10°, they load the bolt in single shear and throw a twisting force into the lever, which must be strengthened to take this twist. Levers that are made horn-shaped in the plane of rotation, or are offset parallel to their axes in order to clear other parts, are not desirable. They are heavier than a straight lever, more difficult to fabricate, and will probably not conform to a standard shape.

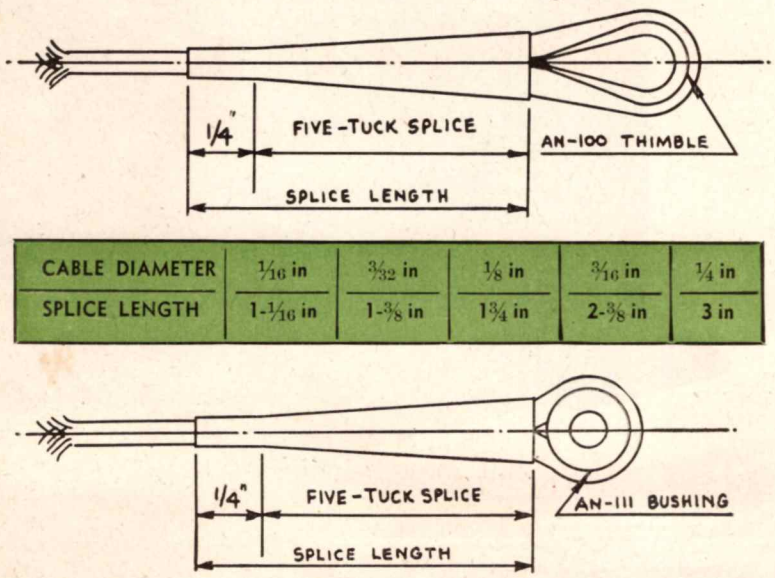
Welded Brackets

Welded steel tube brackets are generally rigid enough if 5/8 in or larger tube is used, but there is a tendency in the design of sheet-metal brackets to choose too light a gage. As a result, the bracket may be flexible and subject to undue wear at the clevis bolts. If in doubt, use the heavier gage; the weight increase will be negligible. Previous drawings of similar parts may be used as a guide in selection of gage if it is known that the part has been satisfactory in operation.

Selection of pulleys and design of pulley brackets should be made with care. Kolde recommends a minimum pulley diameter of 12 times the cable diameter, to prevent overflexing and consequent wear and failure of the cable. Also that the pulley groove be of sufficient size to accommodate the cable without deforming it. Ball bearing pulleys of the AN210 type are universally used. While they have fairly deep grooves, it is general practice to place a guard over them to prevent the cable from jumping the pulley and lying loose or jamming between bracket and pulley. While the guard is a good feature, it does not permit threading cable through the pulley for the cable ends are too large to pass between it and the pulley. Mounting several pulleys on the same shaft is usually essential but makes it necessary to dismantle the entire as-

(*Continued on page* 451)

Fig. 2 Cable diameters and splice lengths



CABLE DIAMETER	1/16 in	3/32 in	1/8 in	3/16 in	1/4 in
SPLICE LENGTH	1-1/16 in	1-3/8 in	1 3/4 in	2-3/8 in	3 in

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AIR TRANSPORT—
Spearhead of our Post-War Prosperity

P. W. LITCHFIELD

NO one can doubt but that the return of peace will bring a tremendous expansion in air transportation, world-wide. That, we can put down as a certainty. The technical strides which have been made, the increases in airplane speed and range under the stimulus of this life-and-death struggle will be reflected in commercial planes of tomorrow carrying passengers and cargo to far places over land and water.

To the thoughtful citizen this necessity is more urgent in the case of the United States, primarily because of our geographical position, than in that of any other nation with the possible exception of Great Britain. And this, not at all for reasons of increased trade, but for vital reasons of national security. We must have commercial air lines for the same reason as in the past we needed a merchant marine, as a secondary line of defense.

Most Powerful Factor

For air power has been demonstrated to be the most powerful factor in the world as respects national strength and independence. As sea power gave England a dominant position among the nations in the last few centuries, so air power will give to the nation, wise enough and resourceful enough to use it, a dominant position in the coming centuries.

America has great resources: iron and other ores, petroleum, forest lands, wheat, cotton and cattle lands, an admirable internal transportation system, mechanical ability widely diffused among its people, the ability and courage—stimulated by our system of free enterprise—to organize these facilities, and a financial system which has been able to stand up under the enormous stresses of war.

We have in our grasp all the facilities we need to keep this land one of well-fed, well-clothed and well-housed people. But we can do so fully, only if we can draw freely on the raw materials of the most distant nations and can sell our goods there, on terms of exchange which will benefit them and us. That means transportation, the most efficient transportation possible.

In the development of the world we need not throw away anything we have used in the past. We shall use the burro and the river-boat in remote sections; we shall use railroads, steamships and automotive transport. But the biggest single development of tomorrow, and the one most closely linked to our national progress and safety, is air travel.

Having made this survey of the importance of air travel, let us turn to the practical means by which it may be achieved. We know we can build superior planes and in any quantity needed. The war proved that. If they happened to cost twice as much as English planes involving the same number of man-hours and pounds of materials, or four times as much as the

Russian or ten times as much as the Japanese, we didn't care. We were out to win a war, not count the cost. But we will have to face that blunt fact in peacetime, when we set rates for cargo and passengers for American aircraft competing with those of other nations.

The difference in cost of construction and operation between the United States and other nations is roughly measured by the difference in wages that go into materials, plants, assembly and crews. We are not going to cut American wages down to the levels paid abroad, even if anyone should want to. The answer must be found elsewhere.

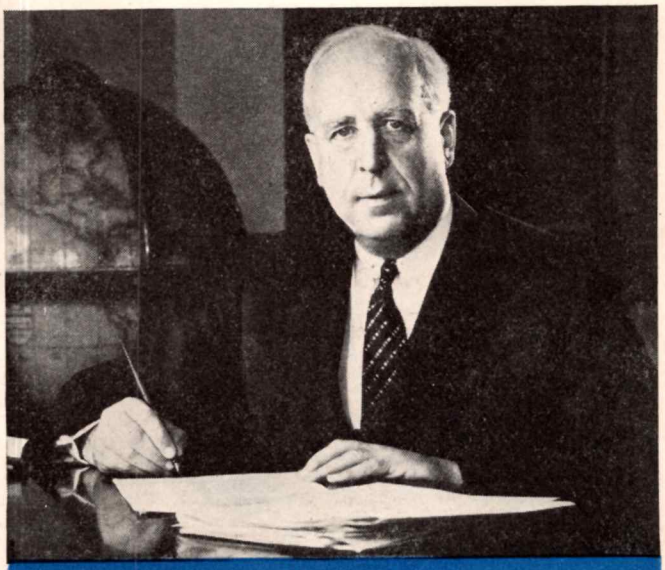
Acute Difference in Costs

This difference in cost of construction and operation of American transport vehicles in international travel is no new one. It is probably more acute than ever before, because the spread between European wages and those in America has widened greatly during the present war; but we had the same problem in peacetime in the case of our merchant marine.

Up to recent years air travel was largely internal. Tomorrow it will be international—air travel will face the same difficulty as has steamship transportation.

In the case of the steamship, we tried to meet the situation by subsidies, but found ourselves like a dog chasing his tail around in circles. For if we subsidized our ships to keep their cargo and passenger rates competitive with those of ships flying other flags, those other nations also could and did subsidize their ships.

The only difference was that our costs being upward of three times as high as those of the next competitor, we had to pay out three times as much. And he could always pay a little more and again outbid us. So we found ourselves following an endless circle—spiral perhaps would be better—in which it was virtually impossible to establish American shipping on an even basis with that of competitor nations.



P. W. Litchfield, Chairman of the Board, Goodyear Tire & Rubber Co., and President, Goodyear Aircraft Corp.

We must find another solution.

A practical one would seem to be to use our strong trading position as a rich commercial market, to insist on a fifty-fifty deal with each nation wanting to trade in the American market.

English, Dutch, Russian, French, Italian, Norwegian or Swedish aircraft, for instance, would be permitted to fly no more schedules and carry no more passengers or tonnage of cargo to America than American planes could fly to their countries. Naturally, the rule would not be rigid, it might vary to 55-45 or even 40-60, for reasons of convenience, but generally speaking we could properly insist that no foreign nation be left in a position to drive America out of the air by reason of cheaper rates. Some division of revenues indeed might be found to preserve our parity in the field.

Wider Foreign Trade

Such a rule would work no hardship on any other nation, but on the other hand would give no advantage to other nations at the expense of our American wage structure and living standards.

We would have some advantage in that we would probably be trading with more foreign nations than would be trading with us, since some nations would not have shipping lines large enough to handle their half of the business.

The question comes up for consideration now in the case of aircraft because now, for the first time, aviation is invading the international field in response to new conditions and in volume beyond any of our present projections in the matter.

(*Continued on page* 292)

About the Author

Associated with the Goodyear Tire & Rubber Co. for more than forty years, P. W. Litchfield, chairman of the board and senior executive officer, has directed the purchase and processing of one-eighth of all the crude rubber ever grown.

In 1940 he relinquished the office of president, but has continued as the company's active head in his capacity as board chairman, concentrating upon matters of national defense such as the development of a supply of rubber—including synthetics—adequate to the country's needs, and aircraft production. He is president of Goodyear Aircraft Corp.

Litchfield was born in 1875, in Boston, Mass., where he attended Massachusetts Institute of Technology, from which he was graduated in 1896. Joining Goodyear at Akron, Ohio, in 1900, as general superintendent in charge of production, he became a director in 1906 and president in 1926.

Under his direction, Goodyear early began application of scientific principles and research to rubber manufacture, and a development department was founded from which have come many vital improvements in the industry. Litchfield established a noteworthy program of industrial relations.

He is widely known for his interest in the lighter-than-air division of aeronautics. During World War I the company built upwards of a thousand such balloons and close to 100 airships for the services.

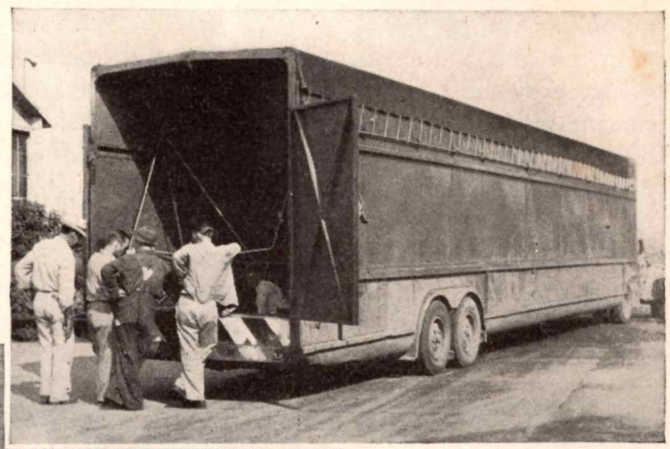
BUILDING THE WACO CG-4A GLIDER

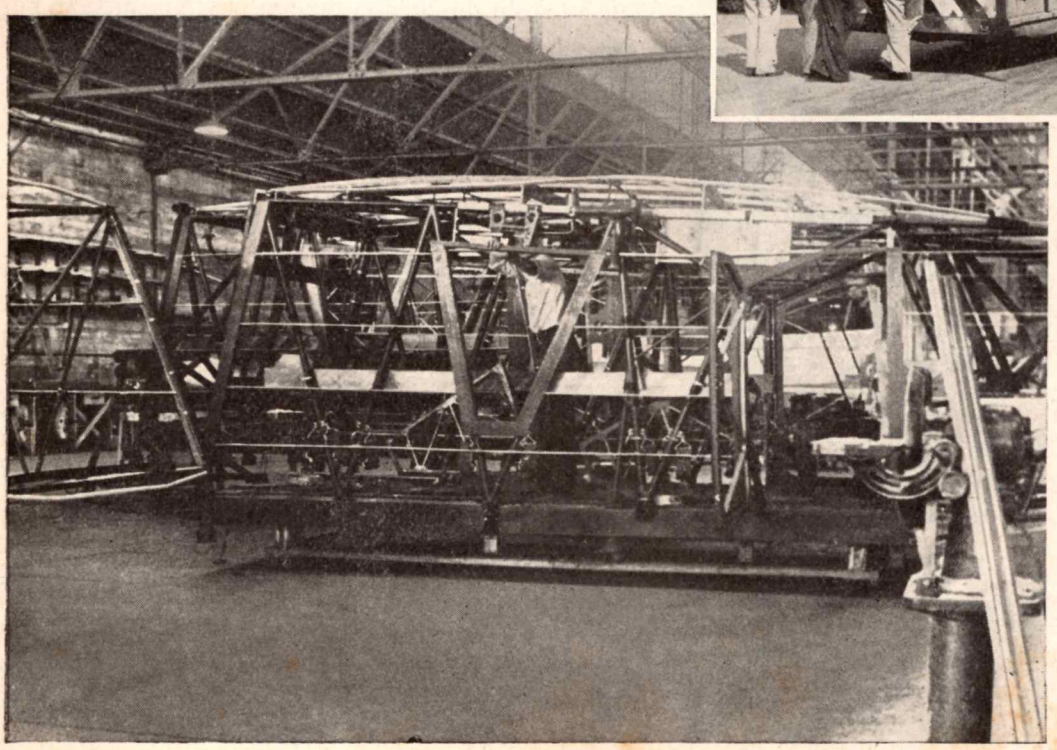
The Waco CG-4A, world's biggest glider. Because descending paratroopers can be spotted more easily than a glider full of commandos, the latter are employed on many types of military missions

● The Waco CG-4A, the Army's 15-place troop carrying transport glider, presents a number of interesting features of design, engineering and manufacture.

Featured by a wing spread of 83 ft 8 in this huge aircraft has an overall length of 48 ft 4 in. Carrying fifteen fully armed and equipped men, two of whom act as pilot and co-pilot, it has two alternate loading arrangements. One of these provides for a standard U. S. Army Ford or Willys ¼-ton truck with four men as crew, plus two

(*Continued on page* 210)





Two complete sets of center fuselage and tail section frames are in each truckload, arriving from Brunswick - Balke - Collender, a Waco sub-contractor

View of frame with controls and woodwork added

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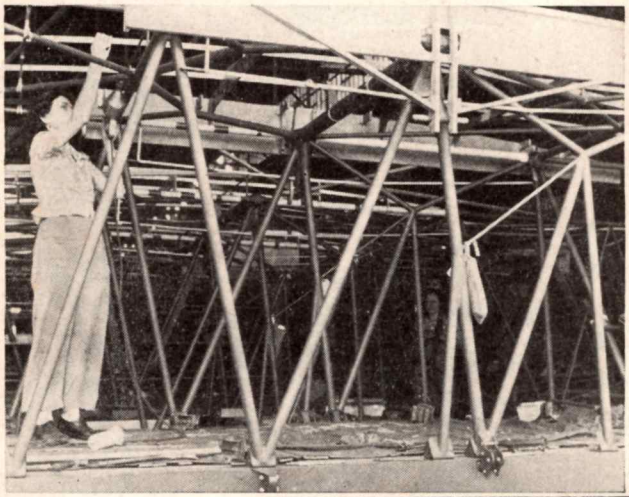


Ready for adding of woodwork and metal controls, a maze of steel tubing starts down assembly line

The building of a glider at the Waco Aircraft plant, Troy, Ohio, may be said to begin with arrival of glider frames and floors, from a sub-contractor.

After the steel tubing frames are unloaded, they go immediately on the assembly line. At this point, the steel tube fuselage gets the wood trim, door frames, and all the controls. Next comes the white cotton twill fabric, which is stretched over the prepared center sections and empennage frames.

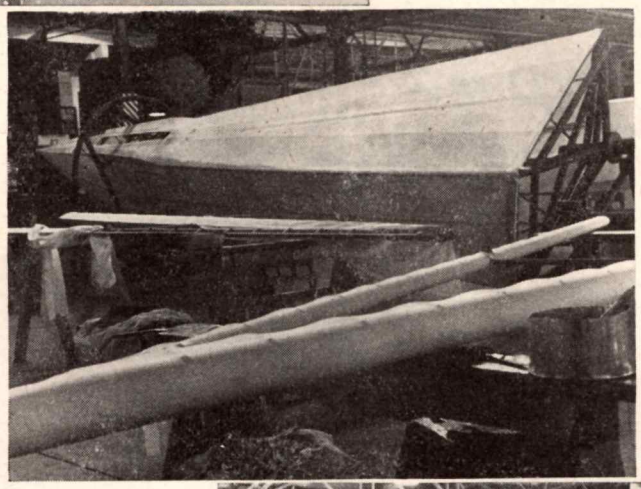
Finishing Cloth-Covered Parts

Following these steps, the frames go to the station where finishing touches are put on the cloth-covered parts. Here, the edges of the fabric are bound, perparatory to the processing that is to follow in the dope room. In the dope room outer surfaces are covered first with a coat of clear dope and then finished with the usual olive drab.

Meanwhile, the wood working department, where some of the finest wood-working talent in the world is employed, has been busy turning out the plywood wings.

All of the various glider components are next moved to another building where they undergo final assembly.

(*Continued on page* 215)



Tail section covered with cotton twill just before going to the dope room for spraying

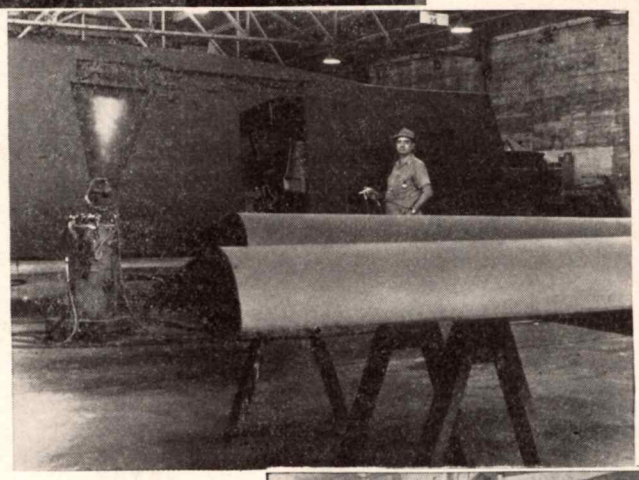
(*Continued from page* 208)

men as extra crew, and extra equipment to make up the full disposable load. The other alternate load is one standard U. S. Army M3A1, 75 mm howitzer and carriage, with gun crew of three plus glider crew of two and ammunition and supplies to make the full available, disposable load.

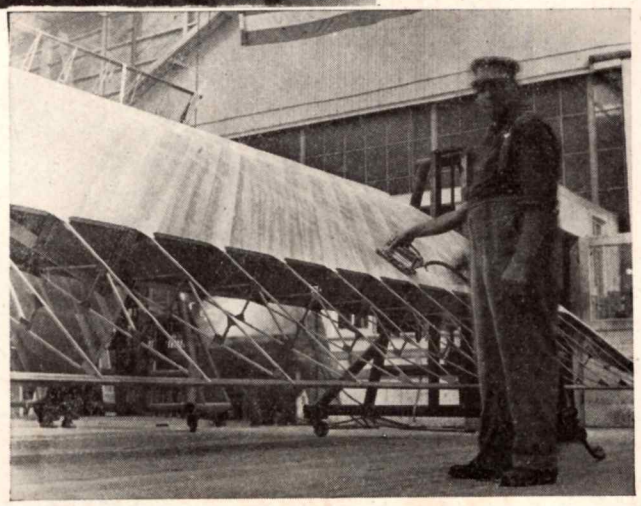
Can Be Towed at 120 mph

The CG-4A weighs more than 7000 lb gross when fully loaded and flies as well at 20,000 ft as at 200. It can be towed by an airplane at a speed of 120 mph or glide lazily at 38 mph without stalling. It is equipped with blind flying instruments, oxygen equipment and most of the complicated devices that are to be found on the modern high speed airplane, with the exception, of course, of the motor.

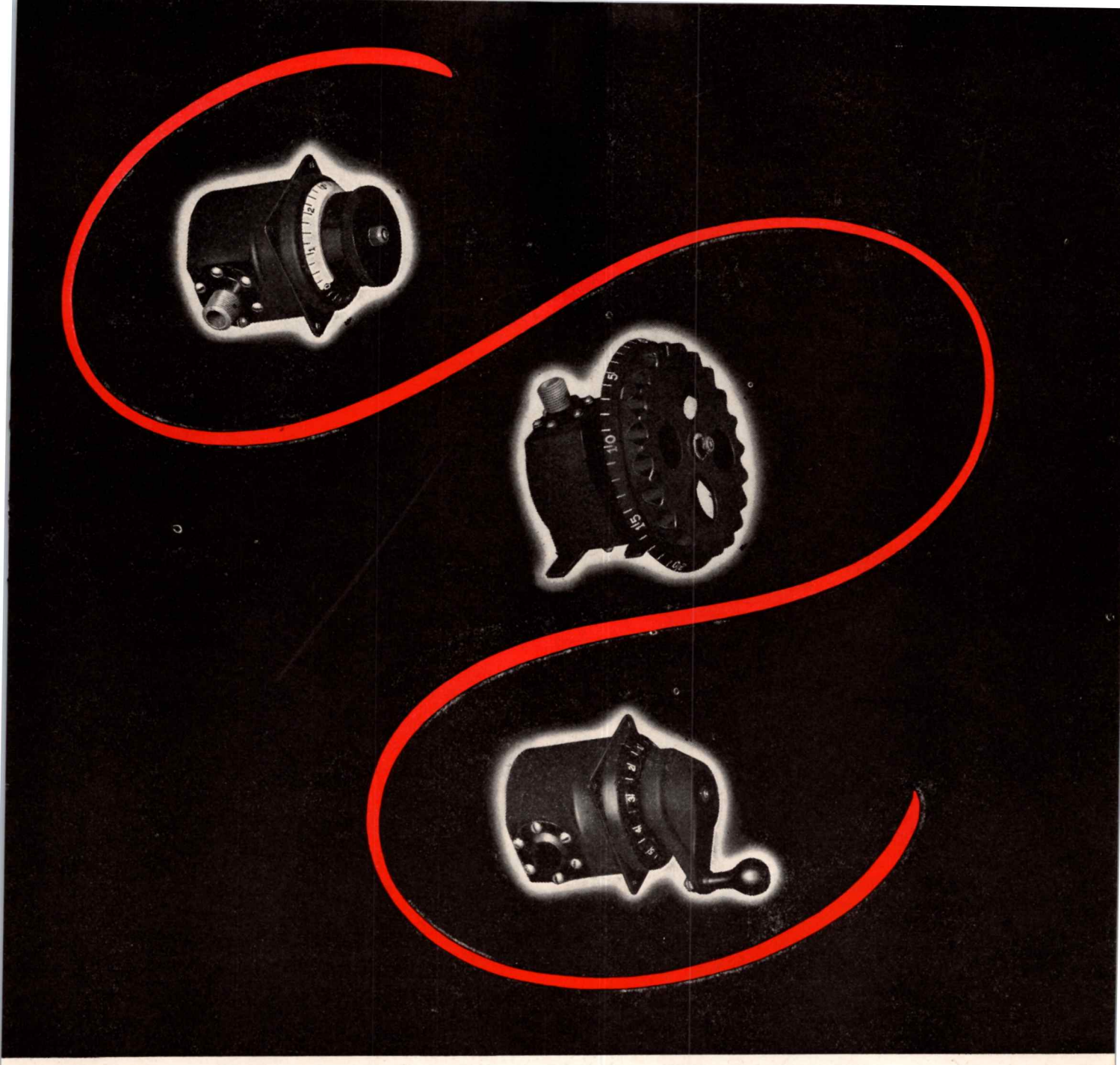
The ratio of a glider's forward progress to its loss of altitude, which ranges from 6-to-1 to 15-to-1 depending on wind direction, weight and other variables, means that even at the minimum ratio a glider towed to an altitude of 25,000 ft could fly more than 25 miles into enemy territory without its presence being detected by the enemy.



Glider center section gets its Army olive drab coat over a primary coat of clear dope



Some of the world's finest artisans in woodworking turn out the glider's plywood wings



RITTER-BUILT PARTS... *to Speed Production*

• THE sub-contracting of many plane parts is well-known as primary factor in America's remarkable aircraft production record. Ritter was among the first to make its facilities available for such work. Among the parts, assemblies and instruments which have been produced, and are being produced, are manual tab controls (such as shown above), propeller-pitch control motors, door-operating mechanisms, landing gear mechanisms, dual control columns and magnetic compasses.

Today Ritter's expanded facilities are available for additional aircraft work which involves heat-treated aluminum alloy castings, precision machine work, plastic molding, electrical wiring, plating and assembly. Air-corps accredited, Ritter is able to take over, from blue-print to final inspection.

Ritter's record is that of meeting specification tolerances—and promised delivery dates. *Ritter Company, Inc., Ritter Park, Rochester 3, N. Y.*

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Second Army-Navy "E," with Star, awarded to Ritter Co., Aug. 31, 1943

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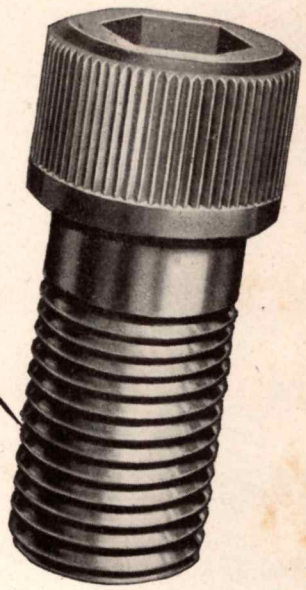
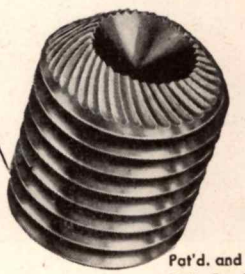


Knurled "Unbrako" Socket Head Cap Screws

The knurled heads prevent time-wasting finger slip and lost motion—help speed production. Knurling also permits locking after countersinking. Sizes: No. 4 to 1 ½" diameter.

"UNBRAKO" Self-Locking Hollow Set Screws with the Knurled Points

Maintenance, time and money savers. When tightened as usual, the knurls dig in and lock the screws in place so they positively won't work loose under vibration. Sizes: No. 4 to 1 ½" diameter.



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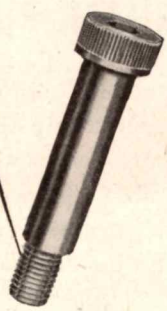

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And the engineers who design his car, truck, tractor and stationary motors also create airplanes that have no equals.

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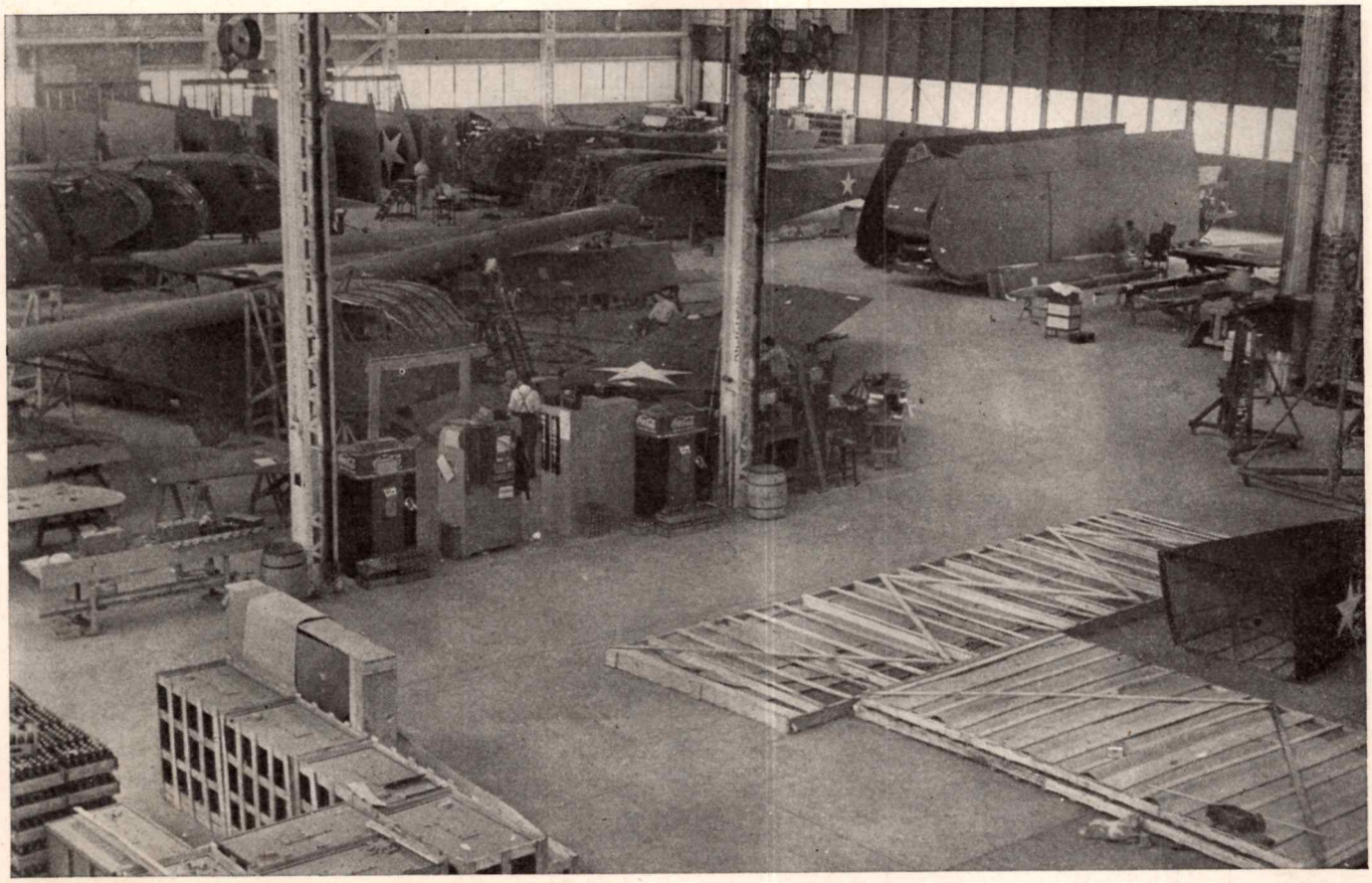


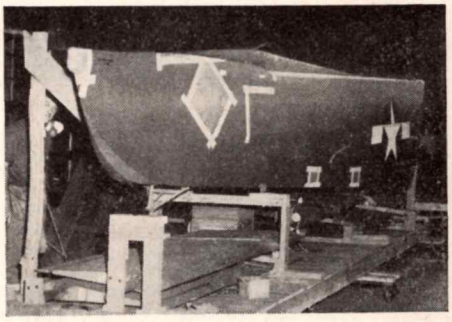
In this building gliders are either assembled and towed away or prepared for crating and shipment—usually by rail

WACO CG-4A GLIDER

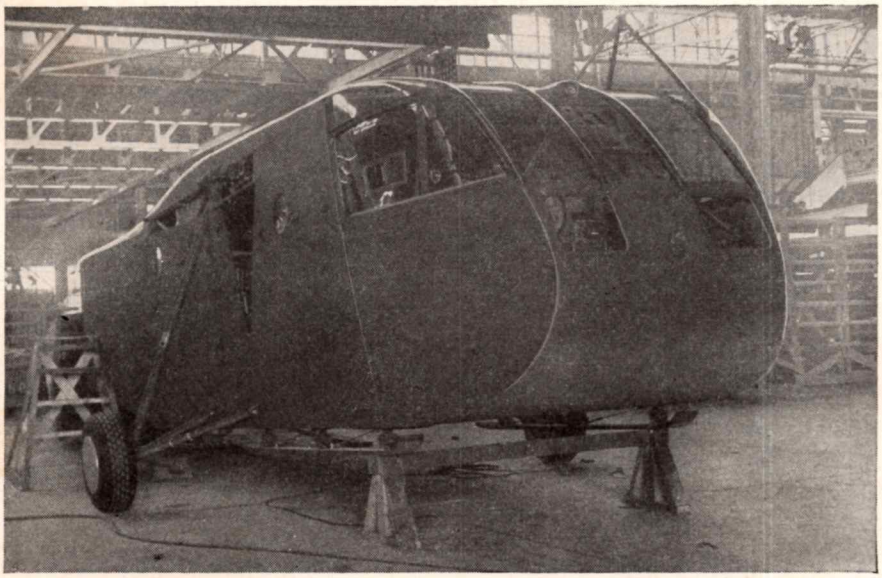
(*Continued from page* 210)

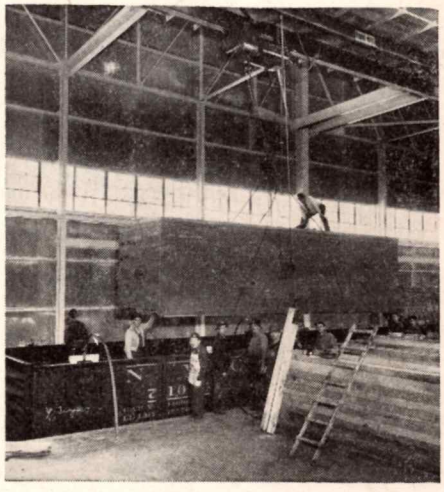
The completed glider now follows one of two courses—it is either assembled and towed away, or it is prepared for crating and shipped, usually in railroad cars. When the aircraft is to be packed for export, it is prepared with the greatest of care. The last picture in the accompanying series shows one box of the five necessary to ship one complete glider overseas.

Before this war is over, according to company officials, Waco will give to the war effort two additional gliders.



Below: Center section, nose and landing gear ready for final assembly. Above, right: Tail assembly and empennage going down the export line for crating. Below, right: One of the five boxes necessary to ship a complete glider overseas





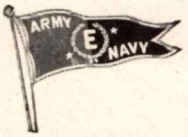
IT'S no accident that that statement appears regularly in communiques from battles areas. It's been planned that way.

American planes and engines have been carefully designed—built to the most exacting specifications. American pilots and crew members—the world's finest—have been carefully selected, thoroughly trained.

After every flight, ground crew men—men who received intensive training, passed rigid examinations for mechanical ability—take over. Engines, planes and instruments are checked with infinite care—adjustments made wherever necessary—every precaution taken to insure mechanical perfection on the next expedition over enemy territory.

It's a safe bet that BONNEY TOOLS play a leading part in making sure of that perfection—help make necessary adjustments quickly, easily—help make possible many of those thrilling, heart-warming reports. Because with tens of thousands of engines produced by leading aircraft engine manufacturers BONNEY TOOLS are standard, original equipment with every engine shipped—selected because of quality proven through the years—quality that has earned them the reputation "the finest that money can buy".

The best engines and planes, skilled fliers, expert ground crews and BONNEY TOOLS—an unbeatable combination. All play their part in helping make possible the safe return of planes carrying America's Fighting Men of the Air.



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HUB products now include . . . *"Live-Line"* hydraulic pumps, hand pumps, gear pumps . . . IHC gear gun turret actuating hydraulic pump . . . *"Levered-Suspension"* landing gear . . . Landing gear for Bell P-39 Airacobra . . . Vickers type oleo strut for Australian Beaufort bombers . . . Landing gear for helicopters . . . USAAF experimental track landing gear . . . Landing gear for Fleetwing B-12 . . . Shock struts for Edo . . . Filters . . . Experimental aircraft, automotive and industrial projects.

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ROBERT TAYLOR, Consulting Radiographer

● Precision in the control of film quality in radiographic work might well be improved by a knowledge of the various paths taken by scattered radiation, and by taking adequate steps to reduce its fogging effect to a minimum. In setting up radiographic technique charts, a knowledge of the devious paths taken by off-focus radiation should lead to a means of reducing its intensity.

In the radiographic examination of aircraft components scattering must be eliminated in order that quality control be maintained at the standard required by Government agencies. The experiments to be discussed here—conducted for the benefit of Aircraft Inspection X-Ray Laboratories—were undertaken for the purpose of determining the sources from which external scattering might reach the film and to what extent film quality might thereby be affected.

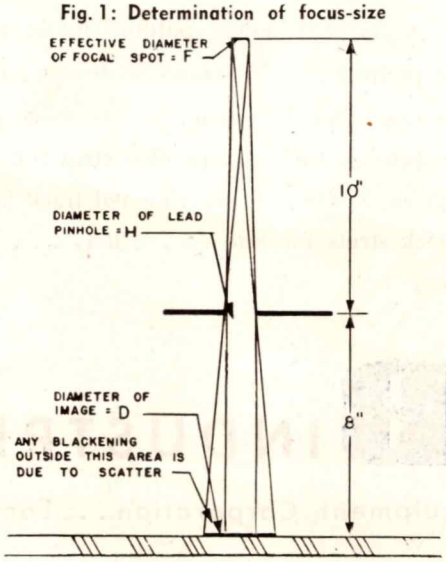
Simple Procedure

A simple experimental procedure is available for analysing the radiation coming from an X-ray tube and cones. This is known as the pin-hole method. Fig. 1 shows the application of this method to the determination of the focus size.

In the present experiments the source-pin-hole distance was 10 in. A pin-hole of 1.5 mm diam was placed in a lead stop of ⅛ in thickness, after which the stop was placed 10 in from the target of the X-ray tube and 8 in from the film—for all studies. All exposures were made at 70 kv peak, leaving one variable factor, the time of exposure. Eastman* no-screen film was selected as the recording media and all radiographs were processed by the time-temperature method in freshly prepared Kodak developer. A cardboard exposure holder with a back lead foil of .003 in thickness was utilized, the film being placed within.

Two exposures were first made, the film being placed on a wooden table. For these exposures the milliampere-second factor was 200. The first exposure, (fig. 2), was made without a diaphragming cone and the second with a cone, (fig. 3). The pin-hole radiographs obtained in these two exposures differed considerably. In the film made without the cone considerable scattering was noticed over the entire film surface, whereas in the film made with use of the cone this scatter was appreciably less.

Fig. 1: Determination of focus-size



$$D = Hx\frac{18}{10} + Fx\frac{8}{10}$$

$$\therefore F = \frac{10D - 18H}{8}$$

In film made by direct exposure, without use of the cone, scatter was considered as maximum compared with other studies wherein some means was utilized for control of scatter.

It was determined that the diaphragming cone limited the X-ray beam to an area within that of the lead stop, and scattering from that portion of the primary beam which passed by and outside the lead stop in the film exposed without use of the cone was eliminated when using the cone. Some scatter which emanated from the walls of the cone was offset by the greater percentage of scatter obtaining outside the area under examination and which was eliminated with the cone's use.

Off-focus forward scatter from the face of the anode outside the target area reached the film in both of these studies, as did scatter from the tube window. In figs. 1 and 2 are shown each of the sources from which scatter reached the film.

Next, two studies were made utilizing the Potter-Bucky diaphragm to learn to what extent scatter might be eliminated with its use. In this instance, to maintain a film density of 1.0 the milliampere-second factor was increased to 800. Considerable reduction in scatter was at once apparent in the Bucky radiographs.

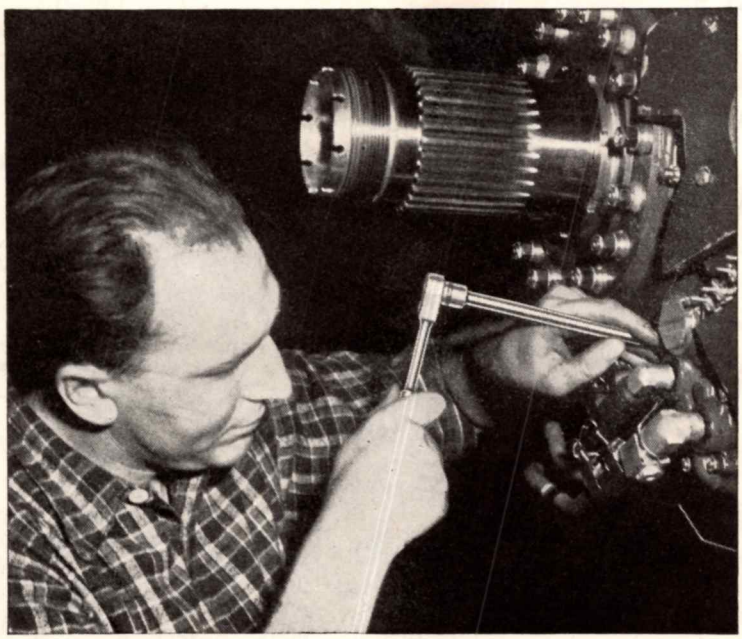
Off-Focus Scatter

Off-focus forward scatter from the face of the anode electrode was visible, but this can be accounted for by the fact that this radiation lined up with the grid in almost the same manner as did the focal radiation.

Figs. 4 (without cone) and 5 (with cone), illustrate source of scatter and the arrest thereof, utilizing the Potter-

(*Continued on page* 220)

*The type of film and processing solutions used for these experiments are given merely to define conditions and without prejudice for or against the product used or that of any other manufacturer.



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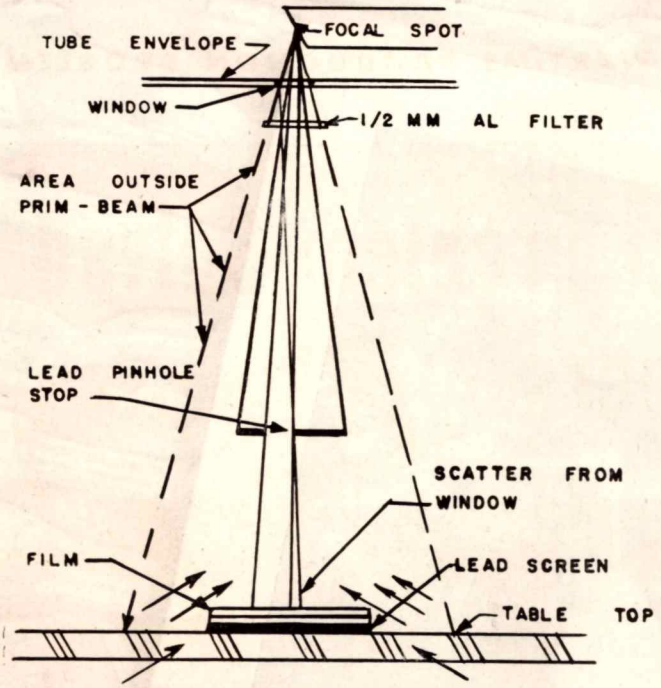


Fig. 2: Direct exposure, without cone

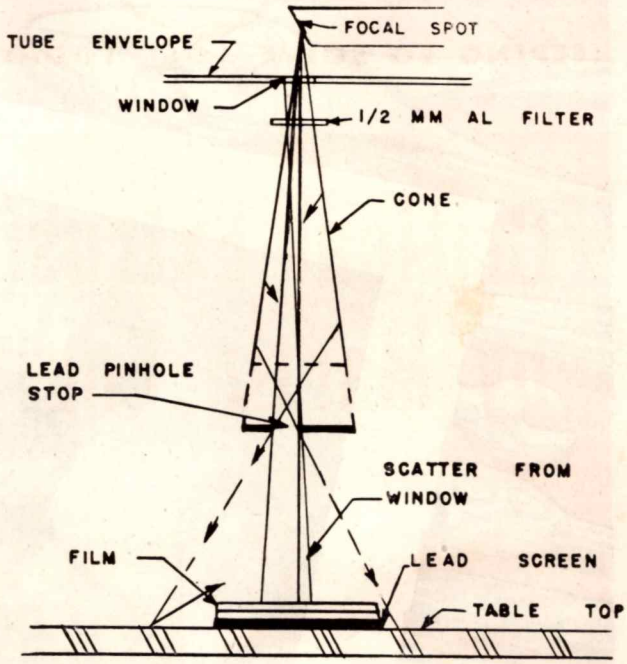


Fig. 3: Direct exposure, with cone

(*Continued from page* 218)

Bucky diaphragm. Scatter from tube window, walls of cone and table top, and from the area outside the primary beam were all arrested, or if not entirely so, the percentage was high in favor of the grid.

The Potter-Bucky diaphragm consists essentially of a moving grid which, during the exposure, passes between the object and the film. This grid is composed of a series of strips of lead held in position by intervening strips of wood. These parallel lead strips absorb the divergent scattered rays from the object being radiographed, so that most of the exposure is made by the primary beam emanating from the focal-spot of the tube.

It is interesting to note that radiation emanating from areas of the anode electrode outside the target area were *not* stopped by the grid.

Use of the Potter-Bucky diaphragm in industrial radiography complicates the technique to some extent and necessarily limits the flexibility of arrangement of the X-ray tube, the specimen and the film. For these reasons it is not used extensively in the industrial field, but rather for research. It is not effective with such penetrating rays as million-volt X-rays and Gamma-rays. These radiations, however, do not cause as much scattering as the lower voltage X-rays.

Special types of this diaphragm have been designed for the radiography

(*Continued on page* 223)

Fig. 4: Utilizing Potter Bucky diaphragm without cone. Grid eliminates about 92.5% of scattered rays

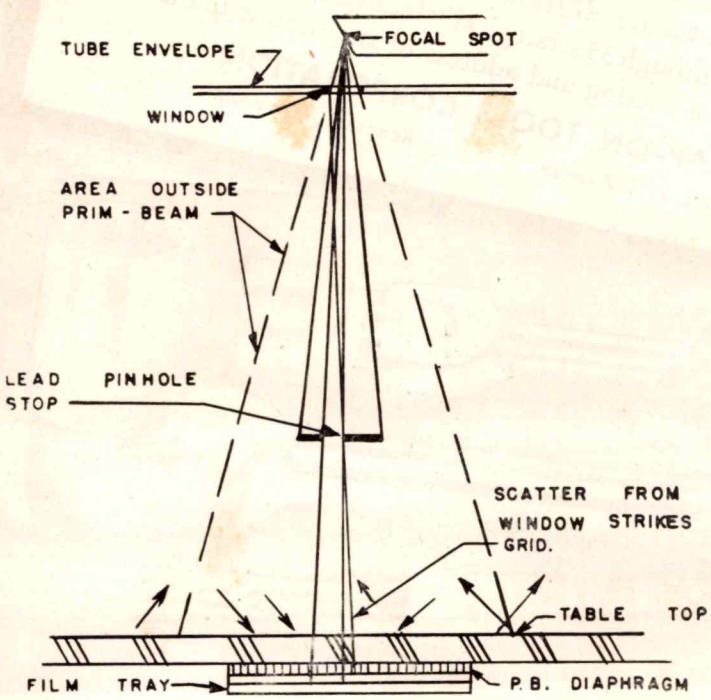
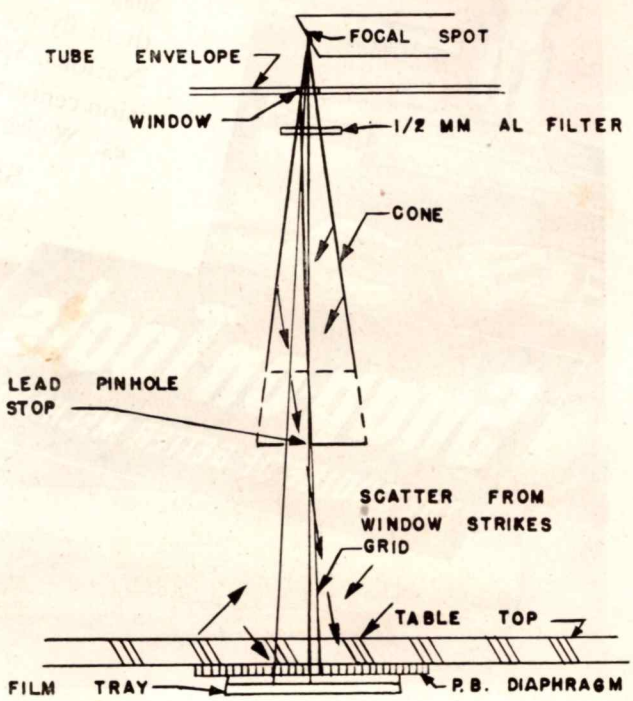


Fig. 5: Potter Bucky diaphragm with cone. Utilizing cone and diaphragm eliminates 95% scatter



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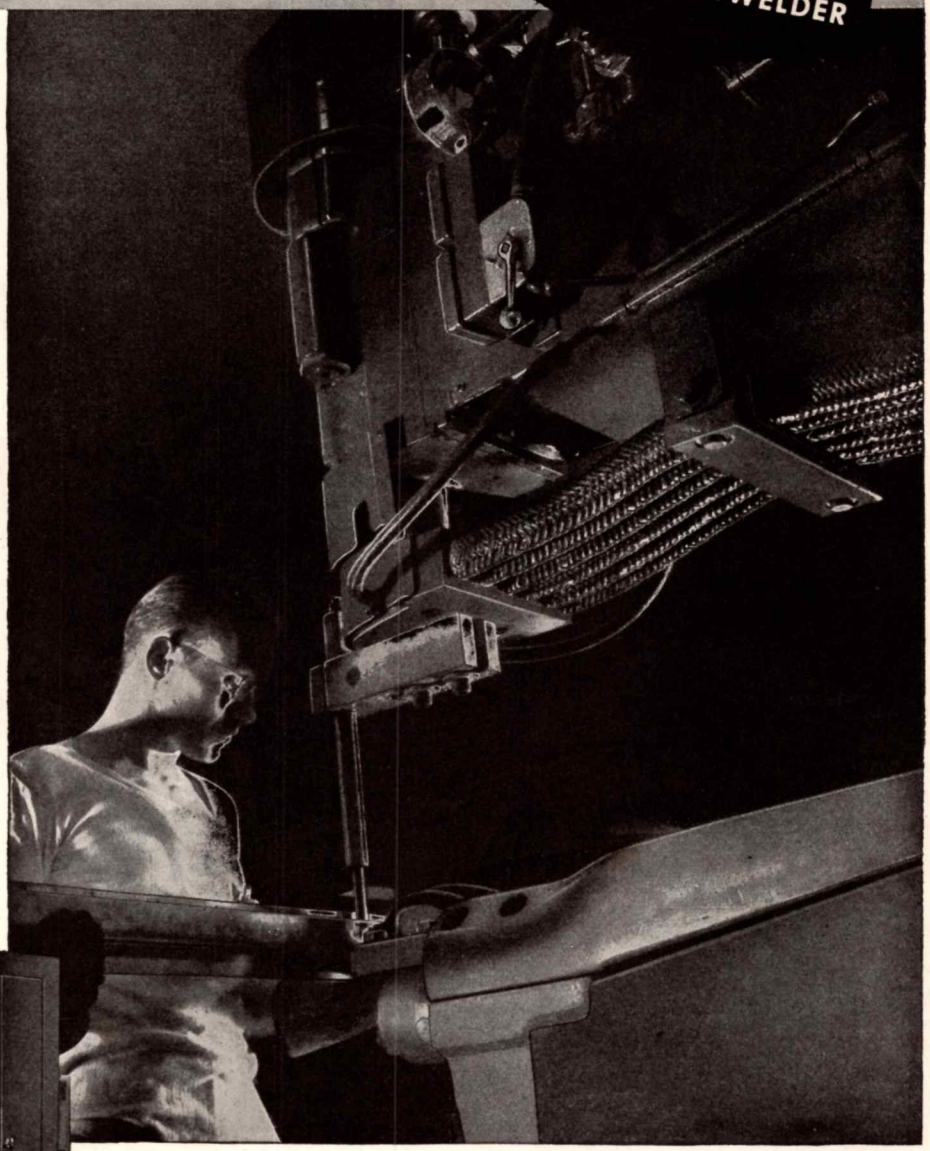

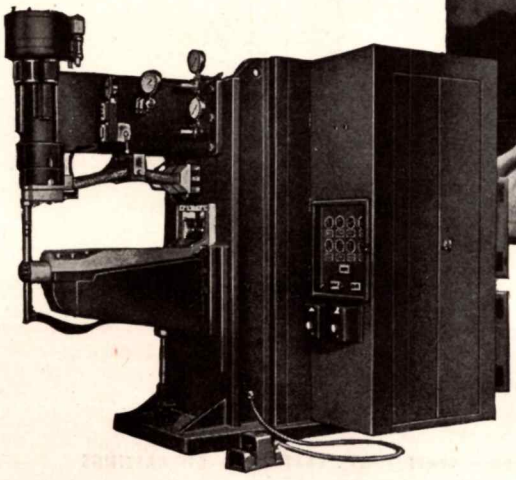

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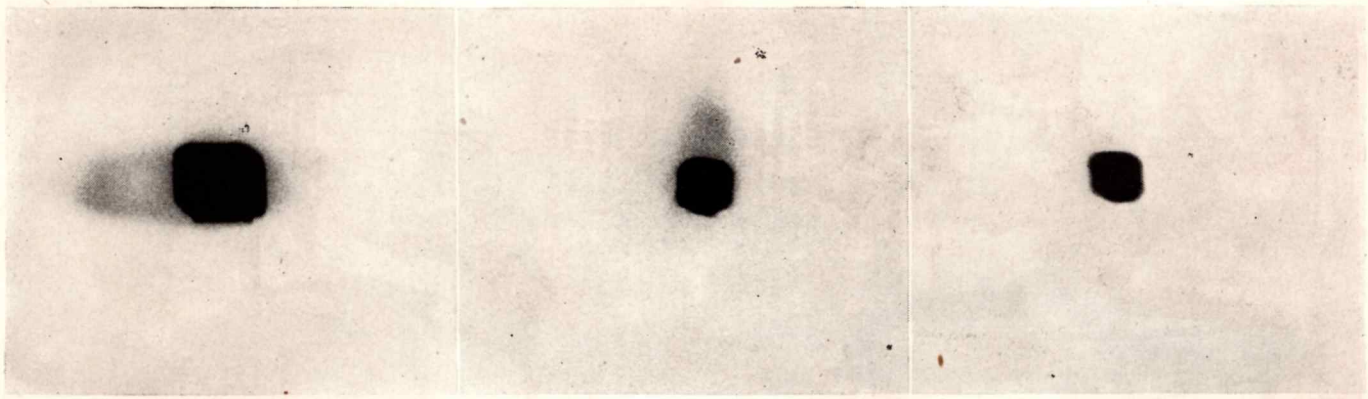


Fig. 6 (left): Pinhole radiograph, utilizing lead-foil screens. Fig. 7 (center): Radiograph, direct exposure with cone. Fig. 8 (right): Same, using diaphragm with cone

(*Continued from page* 220)

of steel with voltages of from 200 to 400 kv. The customary medical type of Potter-Bucky diaphragm, if provided with sufficiently slow grid travel, would doubtless be suitable for X-ray inspection of large aluminum and magnesium castings for aircraft.

The exposure factor is that value by which X-ray energy must be multiplied in going from radiography by direct exposure to radiography with the Potter-Bucky diaphragm, so as to obtain the same degree of density. In this instance most manufacturers have designed their grids so that when the X-ray tube is properly centered and at the correct radial distance from the grid, the exposure factor is approximately 3. The speed factor then, may be determined from the ratio of exposure factors required to produce a film density of 1.0—without and with the grid—when no pin-hole is used and no back-scatter is present.

Use of Lead-Foil Screens

A third study was made utilizing lead-foil intensifying screens in contact with the film, to determine to what extent scattering might be absorbed with their use. These screens also intensify the image by the emission of electrons and secondary X-rays; but their intensifying factor is relatively small, being rarely over 3 in practice. Such intensification is, of course, dependent upon the material being inspected and the kilovoltage used. The matter of their intensification was therefore not taken into consideration in these studies.

All factors likewise remained constant in the lead-foil exposures, with the exception of the milliampere-second factor which was increased from the original 200 by direct exposure to 300 for the screens. There was no visible trace of scatter over the entire film surface, total or near-total absorption having taken place. Since scattering was so appreciably reduced it would be correct to assume that focal radiation was also reduced, and the important point is whether both were reduced by the same or by different percentages.

To determine this an additional pinhole radiograph was exposed with an increase in millampere-seconds to twice that of the initial exposure (600 mas). There was still no off-focus scattered radiation visible in this second film, and it was consequently concluded that the lead-foil screen more strongly absorbs the scattered and off-focus radiation than it does the primary focal radiation. Whereas the exact percentage of intensification offered with the use of lead foil could not be determined, it is generally understood that the intensification factor of any kind of radiographic intensifying screen is defined as the ratio of exposure without it to the exposure with the screen — that will produce some specified density. This intensification factor may be stated rather accurately at 3.

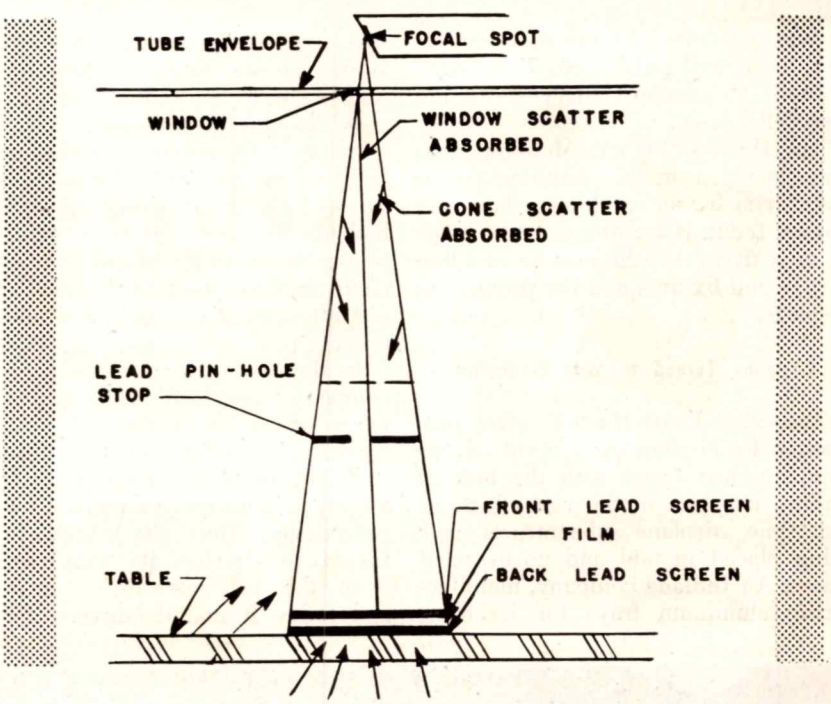
The off-focus radiation emanating from the anode electrode outside the etched target area was *not* present in the lead-foil radiographs, it should be noted, although it appeared in both direct exposure and Potter - Bucky studies.

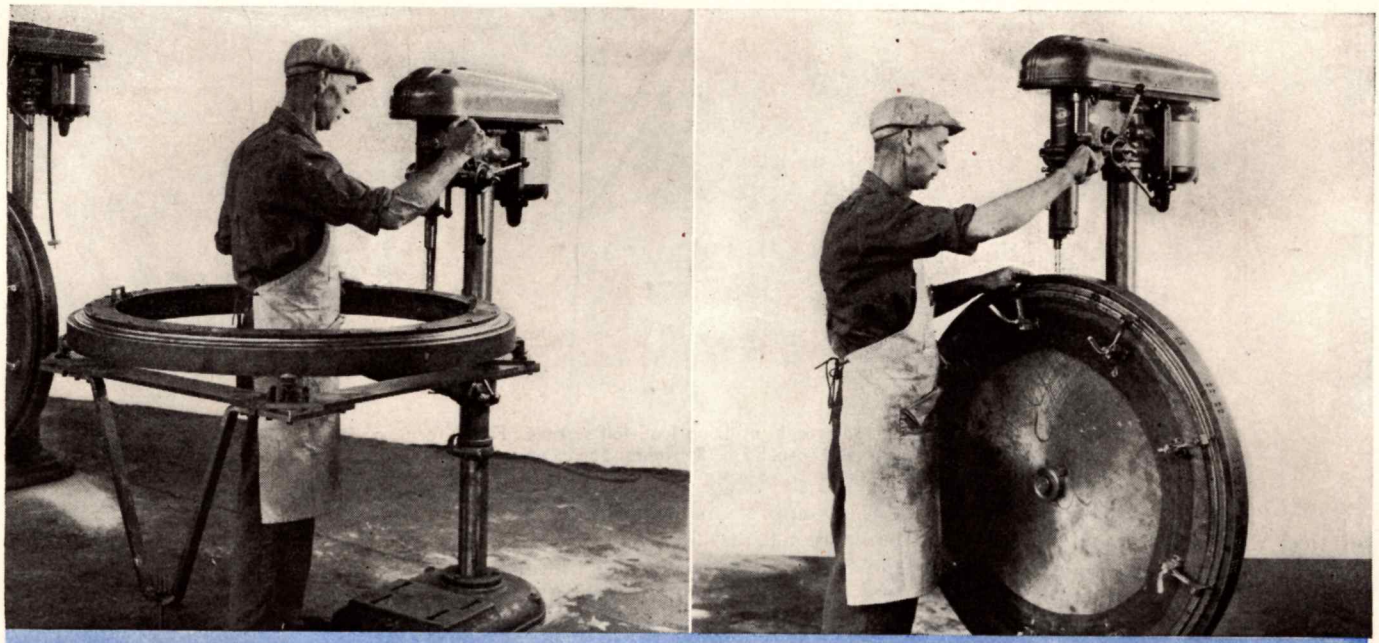
Determining Sources of Back-Scatter

Having determined by the pin-hole method each source from which forward transmitted scatter might reach the film, it was decided to complete the study by determining sources of

(*Continued on page* 292)

Fig. 9: Lead foil exposure with cone. Off-focus scatter, window scatter and scatter from cone absorbed by front lead screen. Back scatter absorbed by back screen





Left: In this fixture the ball turret ring freely rotates to any position for drilling of flange holes. Right: Second step is to drill pairs of holes in the channel base. The fixture rotates on a pivot

AIRCRAFT PARTS AND FIXTURES MANUFACTURE AT HERRON-ZIMMERS PLANT

● War activities of large corporations have been well publicized. The contributions of smaller independents are less well known.

The Herron-Zimmers Moulding Co., once engaged in the manufacture of metal trim for automobiles, offices and homes, today is turning out two kinds of aircraft work—the custom building of jigs and fixtures and the production of parts.

Company Turned to War Production

Following Pearl Harbor, when production for civilian use was cut off, the company was faced with the task of finding its place in the war effort. At that time, airplane subcontracts were being placed in odd and unsuspected places. An Indiana company, manufacturing aluminum trays for iceboxes, was tooling up to manufacture airframe subassemblies. Automotive body builders were beginning to put together wings and tail assemblies.

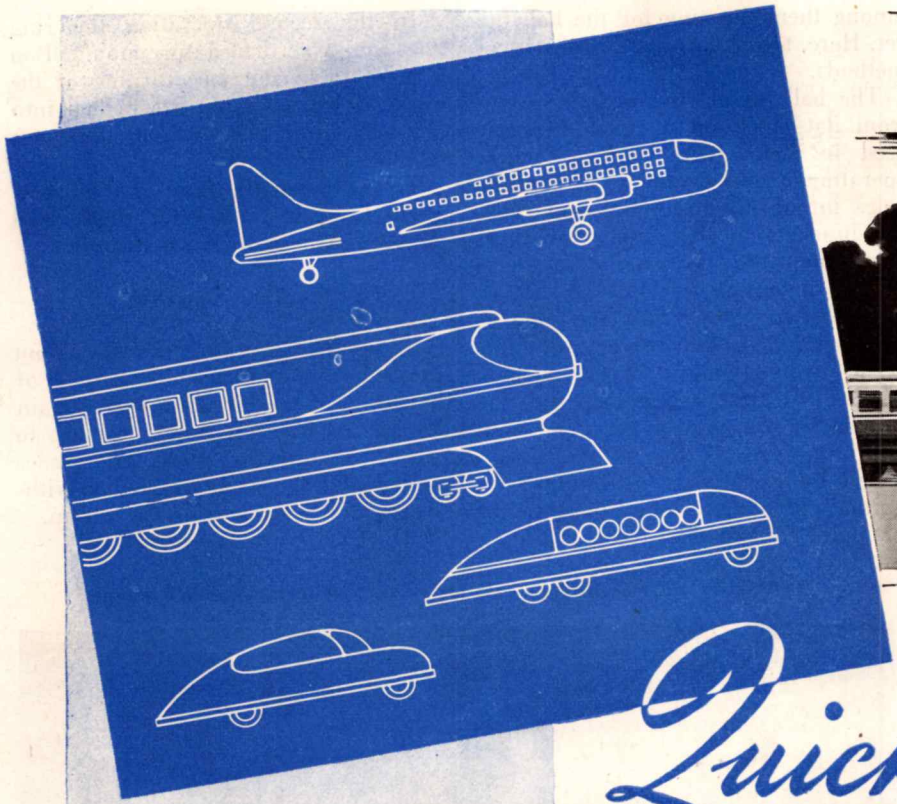
Some of these concerns approached Herron-Zimmers with requests for fixtures. This metal trim manufacturer had no previous experience with such products. Its qualifications were a spacious, modern plant on the outskirts of Detroit, a good tool shop and an engineering staff willing to try anything.

In the case of airframe fixtures, the company found little in the way of previous production experience to draw upon. Fixtures had not been made in sufficient quantity for the evolution of a body of knowledge on which to base procedures. Thus the company was forced to develop its own methods from the subcontractor's blueprints, and today it manufactures a line of products ranging from a small bench jig to an eight-ton center-wing fixture. Methods of manufacture have been worked out that permit of speedy and accurate production.

Procedure in Building Fixtures

In the building of an airframe fixture, Herron-Zimmers begins with cast-steel base plates that have been machined to provide a level surface on which to start construction. These large steel plates are placed on jack screws on the floor and built up level by means of a surveyor's transit. Thereafter, the elevations of various points on the fixture can be measured from the base plates and a high degree of accuracy achieved, so that little normalizing need be done after the fixture is welded.

(*Continued on page* 226)



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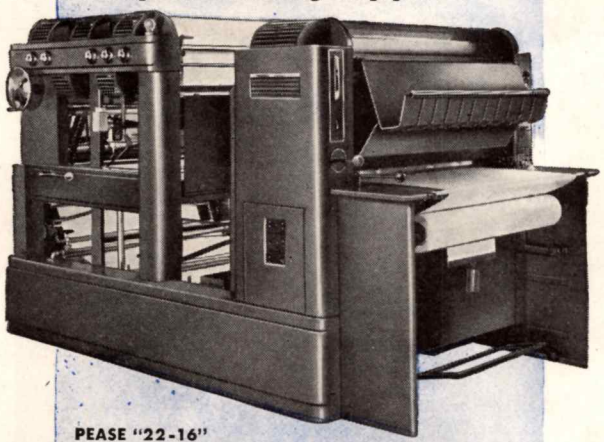

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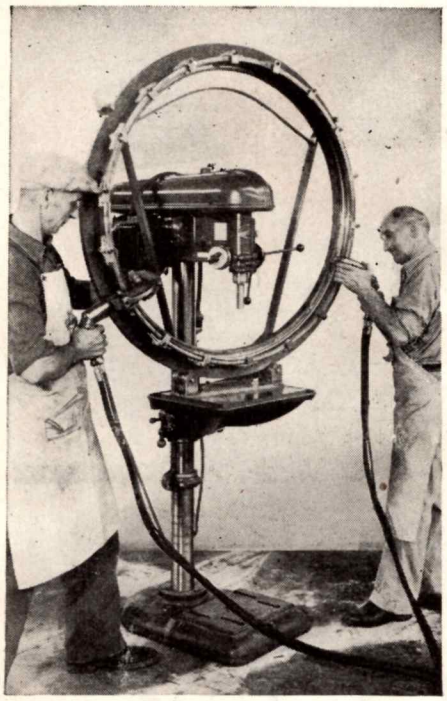


Third step in ball turret ring production is to drill holes on inside of circumference and rivet brackets to the turret ring

(*Continued from page* 224)

The finding of a good means of cutting various sizes of tubing to fit into each other represented another problem. It had been the practice to paste a paper pattern around the tube, after which a workman with hammer and punch marked the tube along the edge of the paper in order to provide a guide for the blowtorch. Cutting with a blowtorch is rough work, and when it comes to fitting the cut tube to the surface of the other tube considerable welding time and material are required to fill in the gaps and make a satisfactory job of it.

Fixture Reduces Welding

To eliminate the excessive welding the company devised a fixture that would hold the tube at any required angle on a vertical mill. The milling cutter was so adjusted that in its revolution it describes an arc, identical with the arc of the tube to which the cut tube is to be fitted. As a result, the tube from the vertical mill fits exactly over the surface of the other. In case tubes are out of round, a hand grinder is used to insure an accurate fit.

Because of their acquired know-how, Herron-Zimmers has been able to maintain a schedule of fast deliveries. One of the early jobs, an eight-ton fixture, was turned out in a month.

Recently the company has been asked to manufacture aircraft parts, among them the ring for the ball turret. Here, too, it has developed its own methods.

The ball turret ring is first formed from flat stock on a roller formerly used in metal trim work. Machine operations consist chiefly of drilling holes in the circumference and riveting brackets to the ring. For these operations, the company's engineers devised ingenious fixtures.

In the first operation the ring is mounted horizontally on a drill table in a company-made fixture which works on roller bearings to permit the turning of the part to any position. The outer end of this fixture is supported by an adjustable standard, to maintain it in a horizontal position. At this point flange holes are drilled.

In the second operation the ring goes into a vertical fixture mounted on a pivot to permit free turning of the work. Holes, in pairs, are drilled into the base of the channel on the outer diameter.

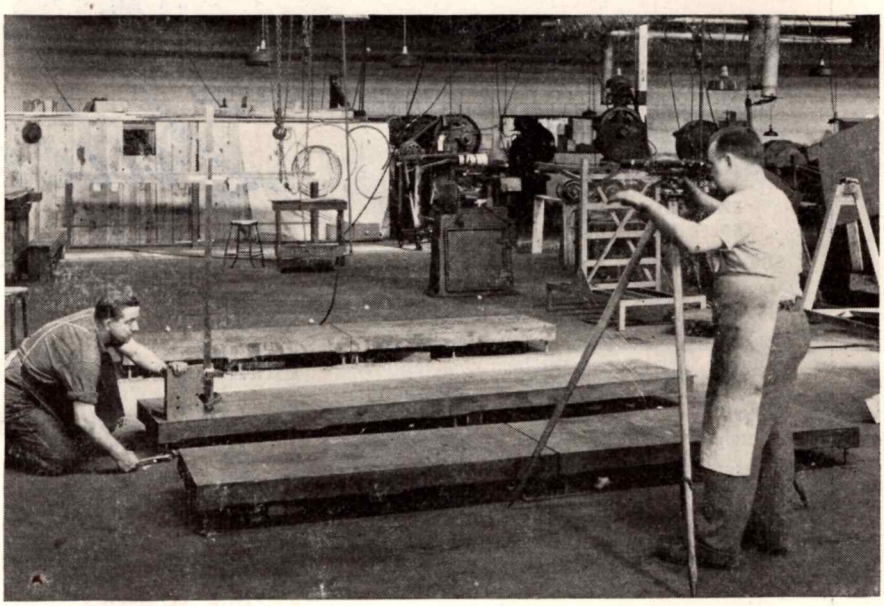
To cut down the time of this operation by half a special drill head mounting two drills has been built.

The Third Operation

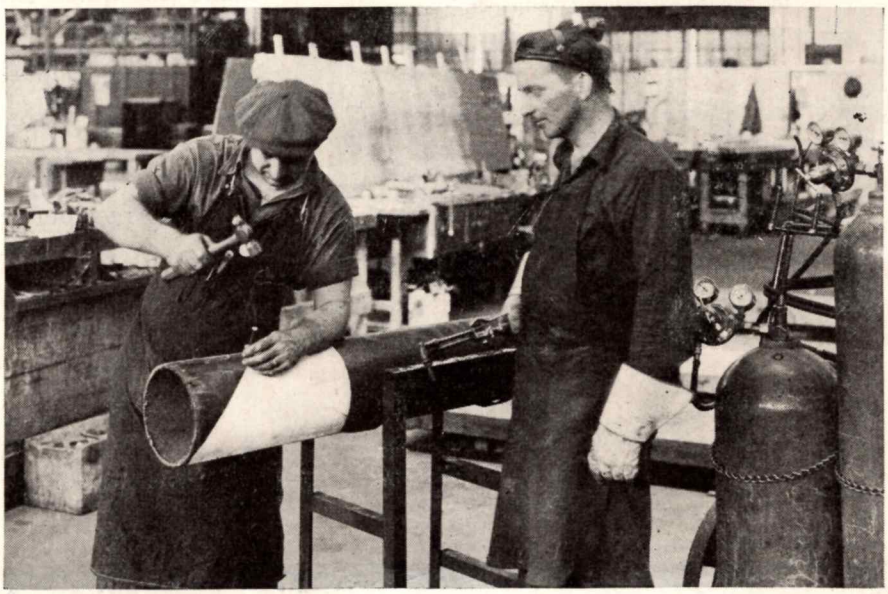
In the third operation the ring is put into a fixture that permits drilling of the inside of the circumference. Again the fixture rests on roller bearings to permit free turning. Here, after holes are drilled, brackets are riveted on without removing work from the set-up.

(*Continued on page* 228)

In building airframe fixtures, base plates are first adjusted with a transit



In cutting tubes, paper patterns with edges punch-marked guide the blow torch



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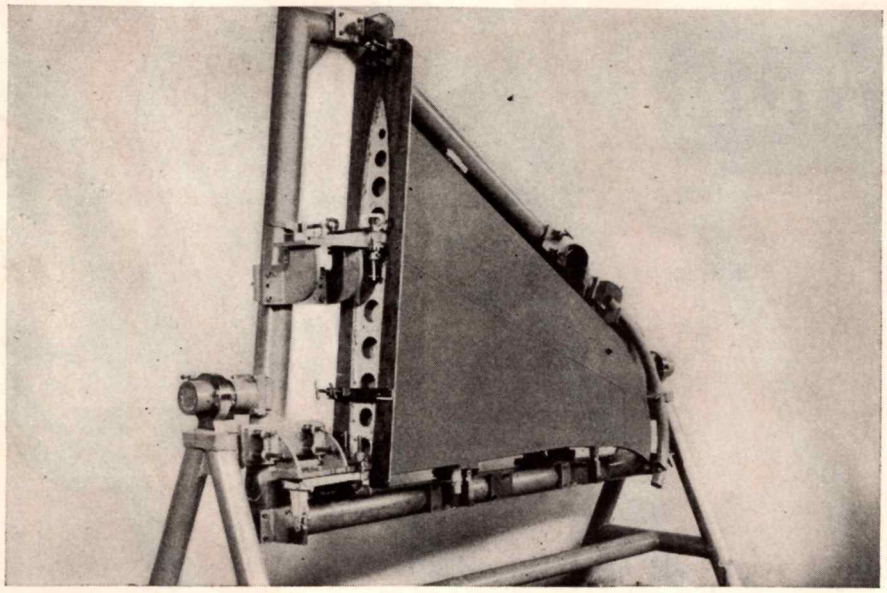
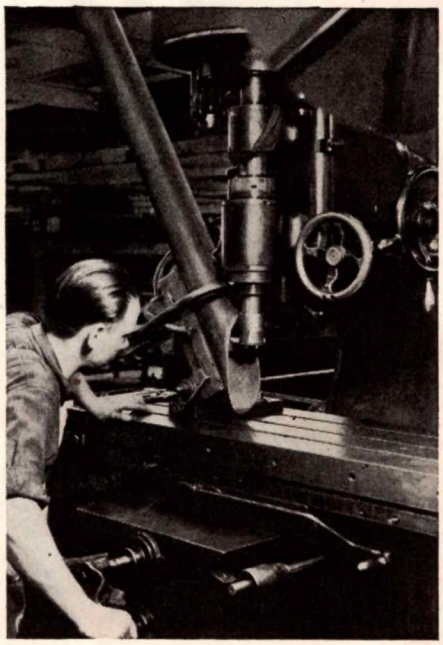
(*Continued from page* 226)

What is happening at Herron-Zimmers is happening in greater or less degree among the many thousands of small independent factories throughout the country, where vital if unspectacular contributions are being made to the war effort. To a considerable extent the victory rests with the engineering ingenuity and adaptability of these firms.





Above: To insure a clean job the cut tube is milled. Left: A completed Herron-Zimmers wing fixture

Conversion of the P-39 into a Trainer

● A cardinal problem faced by the Army Air Forces in training fighter pilots has been the necessity for all final instruction to be given on the ground, because the fighters were all single seaters. The new pilot was on his own. He could have no expert flying with him, to explain the differences between the fighter and the advanced trainer the trainee had been flying.

It was this circumstance which prompted the request made by the West Coast's Fourth Fighter Command and the Fourth Air Force of Bell Aircraft's Niagara Frontier Division, to modify a production P-39 *Airacobra* so that it could carry two pilots. The basic specification for the two-place version was that it should have the same flight characteristics as the combat model, and be able to perform normal flight maneuvers.

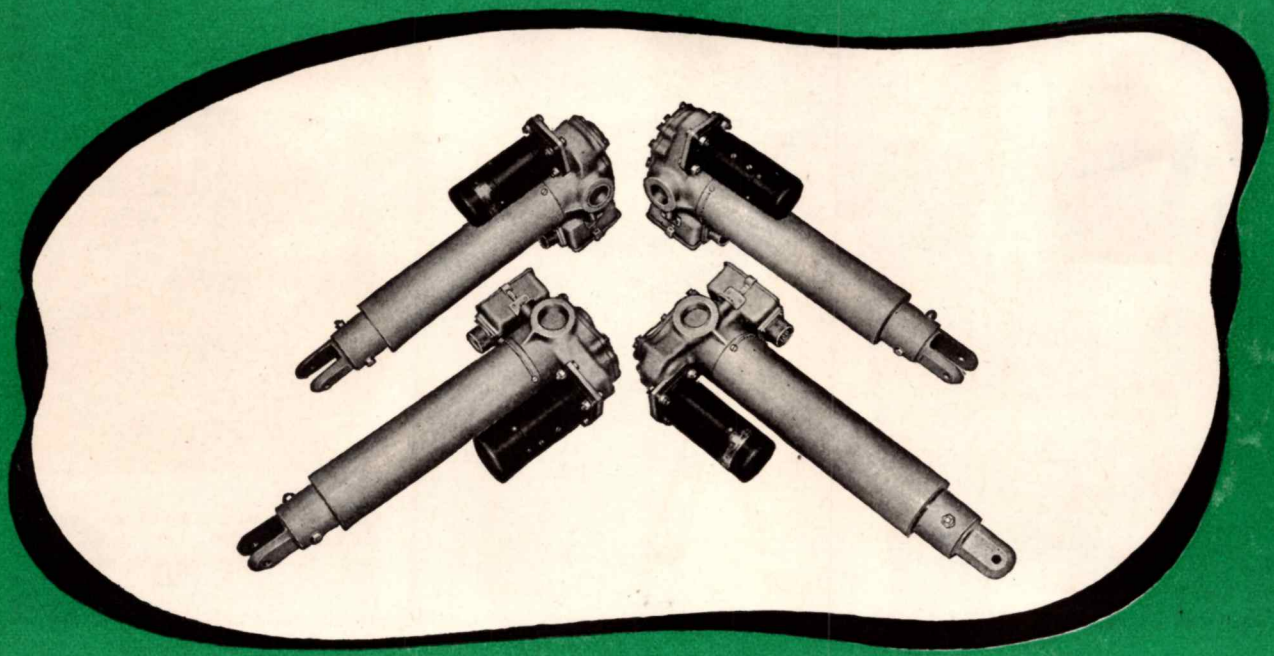
To find the space needed for the instructor, because of the engine's location directly aft of the pilot in the combat model, it was necessary to go forward, and to remove the 37 mm cannon, fuselage machine guns and gun cowling. The plexiglas cabin covering was extended to cover two seats instead of one, and a full set of controls as well as a simplified instrument panel were installed in the forward cockpit. Nor was this all, for to maintain directional stability the dorsal fin had to be enlarged and a small auxiliary fin attached to the bottom of the fuselage.

As built, the TP-39 is interchangeable with the production *Airacobra*, and any P-39 can be transformed into a trainer by installation of the special kit of parts which can be made up, and shipped anywhere.

Conversely, if a trainer should be located in a combat zone, and an additional fighter were needed, the front cockpit installation could be easily and quickly removed, the armament put back in place and the airplane sent into battle.

Conversion of Army P-39 "Airacobra" into a two-place trainer (TP-39) was accomplished by removing the 37 mm cannon, fuselage machine guns and gun cowling, and extending the cabin enclosure forward. The second pilot's "office" is equipped with a full set of controls and a simplified instrument panel

PACIFIC ACTUATORS



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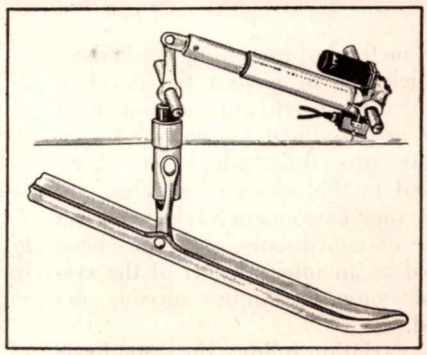

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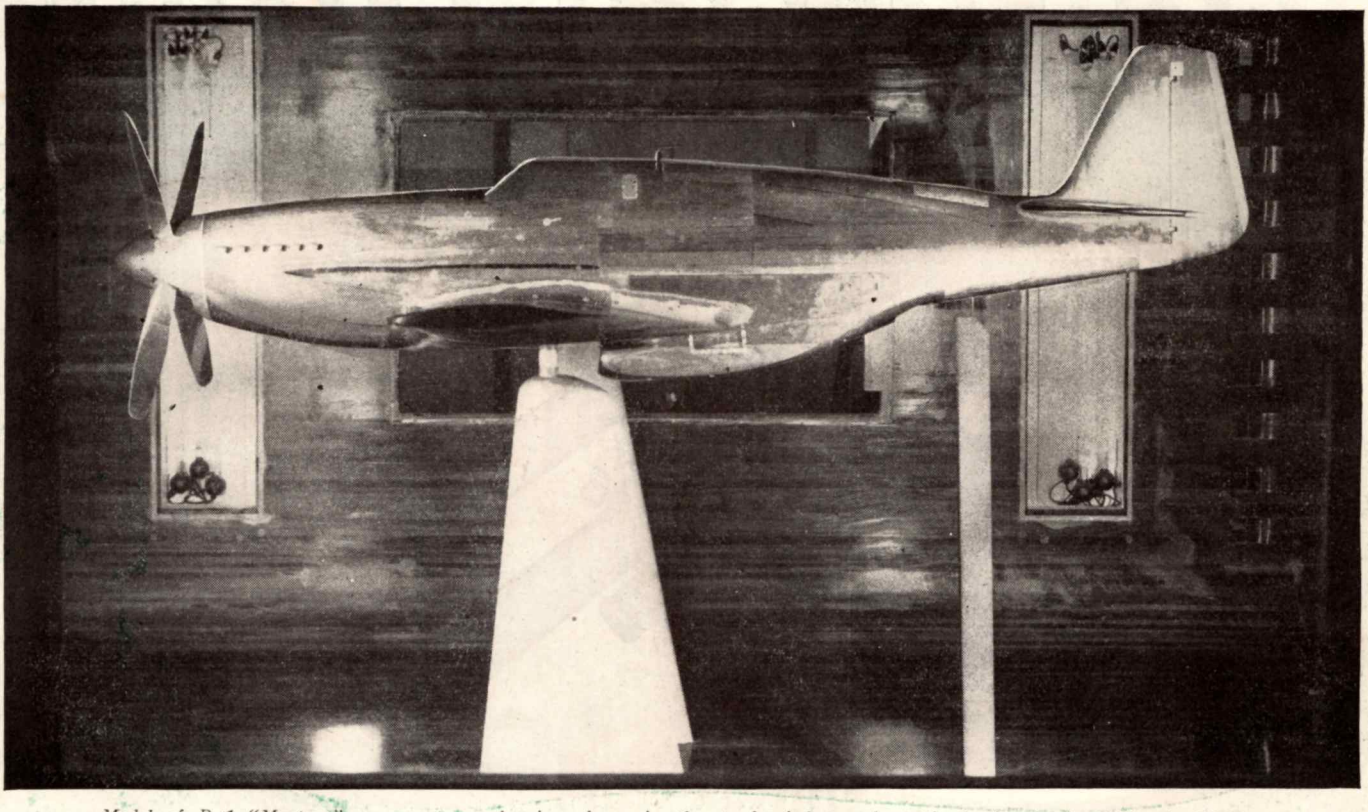


Model of P-51 "Mustang", one-quarter scale size, shown in throat of wind tunnel at North American's California Division

LOFTING PROBLEMS of *Streamline Bodies*

[PART 19]

CARTER M. HARTLEY, Chief Loftsman, and
ROY A. LIMING, Charge, Lofting Engineering Loft Mathematics,
North American Aviation, Inc.

THE method of presenting basic data, which are to govern the development of a required conic section, is of course not confined to the purely coordinate procedure which has been analyzed in this series of articles. Indeed a very convenient variation from the use of coordinates alone has been adopted as an integral part of the system of conic techniques already described.

This variation follows the same basic pattern and is based upon the same familiar principles of projective geometry that have been indicated throughout this investigation. In some respects, however, the analytic procedures required are somewhat simpler and more conveniently resolved by standard calculation routines than in the purely coordinate approach.

For systematic calculation purposes all conic sections may be considered as one or the other of two types, i.e., (a) with at least one tangent parallel to a reference axis, or (b) with neither tangent parallel to a reference axis. Actually type (a) is a special case of type (b), and can be developed from the same general picture that has been indicated for type (b).

However, a large number of curves of type (a) are normally encountered, not only in side and plan view developments, but also in the body plan view. A considerable saving of time and trouble is effected by establishing a special formula and set of calculation charts for this type.

Fig. 85 illustrates a curve of type (a) with basic conditions defined primarily in terms of slopes. The slope of the common chord line t_1 is given as m_1. The slopes of the two tangents t_2 and t_3 to the required conic are designated as m_2 and m_3 respectively. Assume as the coordinates of the shoulder or control point the values d, e, and the intercept of t_2 on the x-axis as a.

Then the following equations result:

Equation of t_1 : $y - m_1 x = 0$ ..... (121)
Equation of t_2 : $y - m_2 x + am_2 = 0$ .... (122)
Equation of t_3 : $y = 0$ ..... (123)

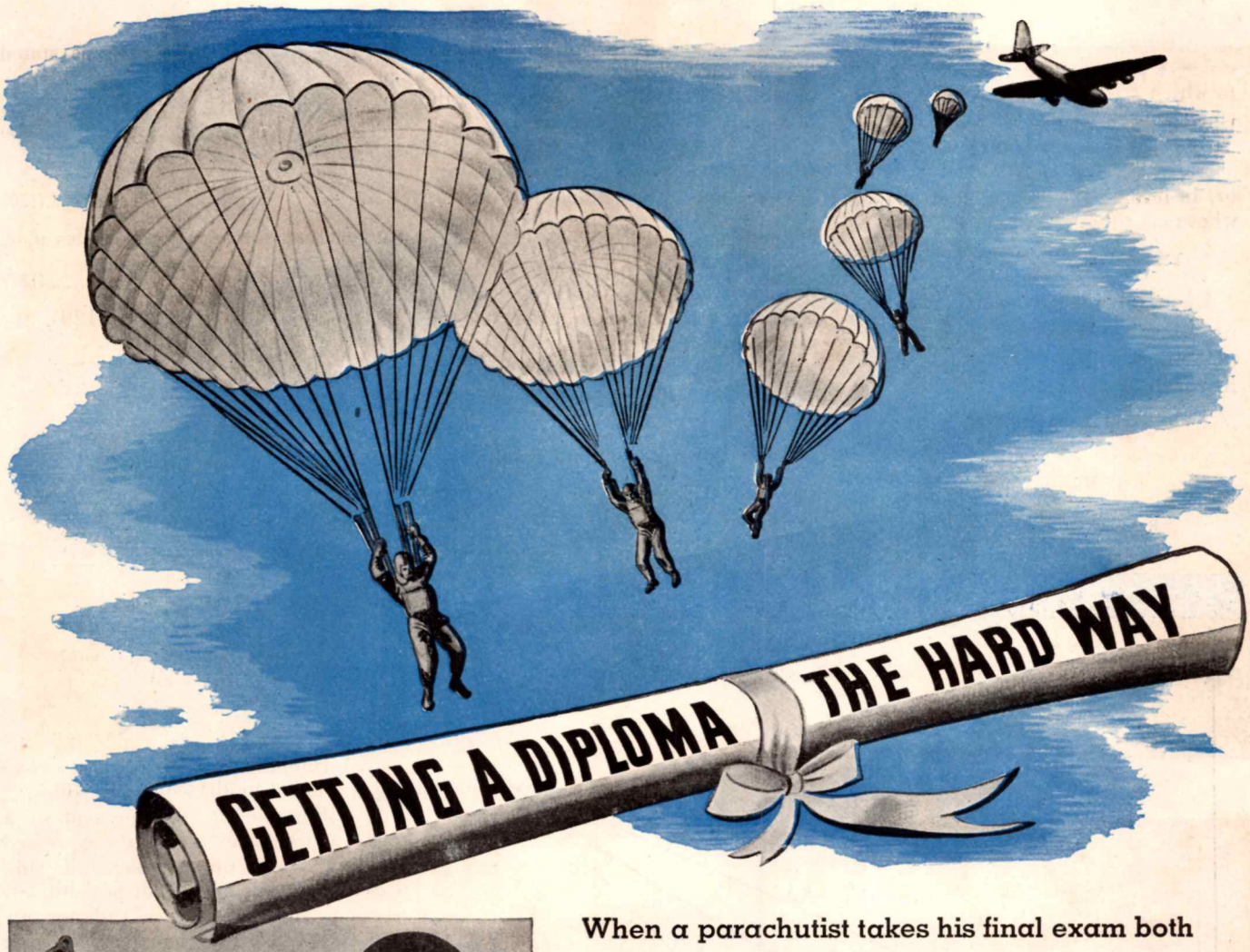
It is also known that

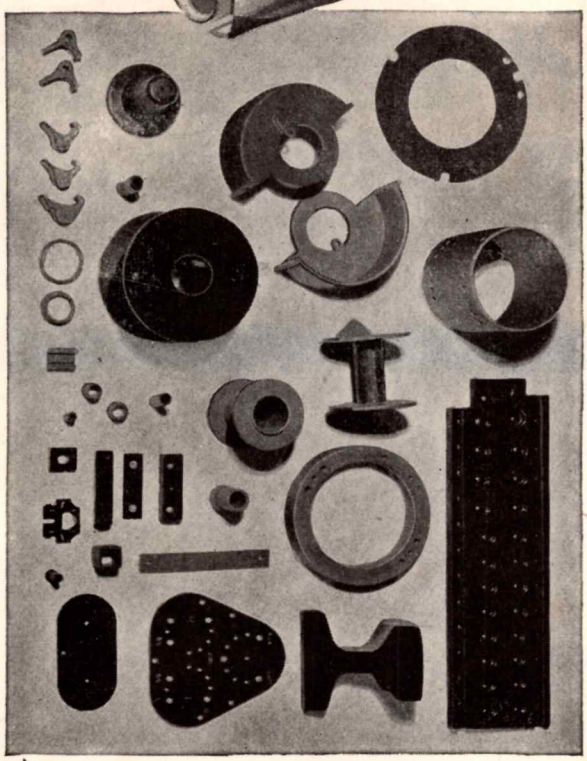
$t_2 t_3 + k (t_1)^2 = 0$ ..... (124)

represents the family of degenerate conics tangent to t_2 and t_3 at B and O respectively.

By substitution of equations (121), (122) and (123) in equation (124), there results the following expression,

(*Continued on page* 232)





When a parachutist takes his final exam both his diploma and his life depend on the fitness of his rip cord.

Lives also frequently depend upon the fitness of inconspicuous radio and electrical parts of Formica laminated plastic used in war equipment — such parts as insulating spools, insulating spacers, breaker arms, radio tube socket bases, terminal strips, rheostat cores and other insulating parts.

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ARMY E NAVY

FORMICA

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(*Continued from page* 230)

$$(y - m_2x + am_2)y + k(y - m_1x)^2 = 0 \quad (125)$$

in which k is a parameter. The parameter (k) is evaluated as

$$k = -\frac{(y - m_2x + am_2)y}{(y - m_1x)^2} \quad (126)$$

or, in terms of the given control point whose coordinates are (d, e), as

$$k = -\frac{(e - m_2d + am_2)e}{(e - m_1d)^2} \quad (127)$$

Upon solving equation (125) for $y = f(x)$, it is found that

$$y = Px + Q \pm \sqrt{Rx^2 + Sx + T}$$

in which

$$P = \frac{m_2 + 2m_1k}{2(1 + k)}$$

$$Q = \frac{-am_2}{2(1 + k)}$$

$$R = \frac{m_2^2 + 4m_1k(m_2 - m_1)}{4(1 + k)^2}$$

$$S = \frac{-am_2(m_2 + 2m_1k)}{2(1 + k)^2}$$

$$T = \frac{a^2m_2}{4(1 + k)^2} = Q^2$$

A formula expressing $x = f(y)$ may be developed by the same procedure.

To illustrate the application of the foregoing method, assume the following conditions governing the development of a fuselage lower shoulder line, aft section, side view:

$m_1 = 0.09244901$
$m_2 = 0.20359848$
$m_3 = 0$
$d = 124.472$
$e = 6.25$
$a = 124.472$

Then, by substitution, it is found that $k = -1.34867521$, and

$$y = 0.069501x + 36.3409 - \sqrt{-0.028948x^2 + 5.051419x + 1320.657789}$$

The actual calculation of the equation constants is performed by the use of the type of chart discussed in the preceding articles of this series.

Fig. 80 illustrates the more general curve type (b), in which neither tangent is parallel to a reference axis. In this case, t_1 represents the common chord line with slope m_1, t_2 and t_3 representing the given tangents to the required conic at points O and B respectively; m_2 and m_3 represent the given slopes. The intercept of t_2 on the y-axis is b. The coordinates of the shoulder or control point on the curve are given as d, e.

The following equations result:

Equation of t_1 : $y - m_1x = 0$ ..... (128)
Equation of t_2 : $y - m_2x - b = 0$
Equation of t_3 : $y - m_3x = 0$

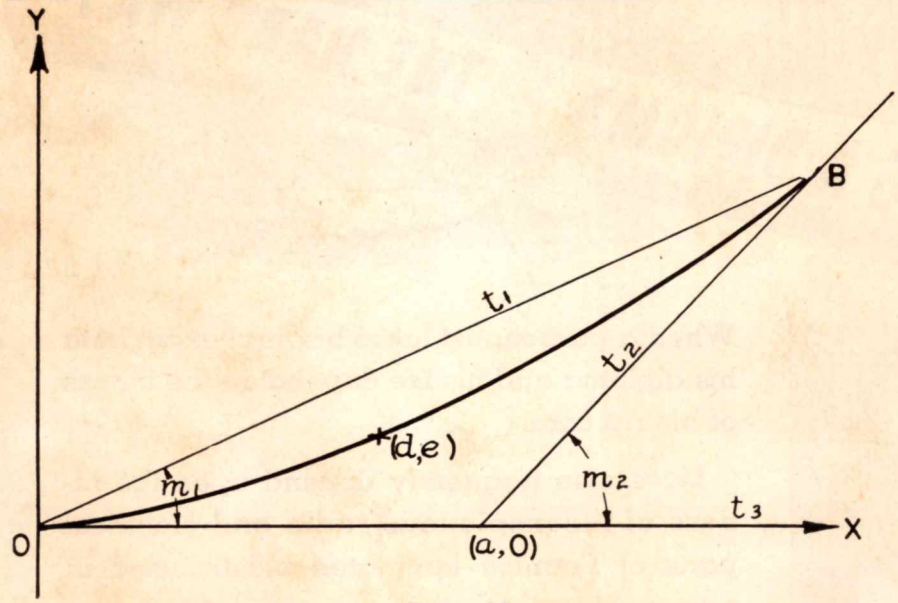

Figure 85

Since $t_2t_3 + k(t_1)^2 = 0$, as stated previously, then

$$(y - m_3x)(y - m_2x - b) + k(y - m_1x)^2 = 0 \quad (129)$$

whence

$$k = \frac{(y - m_3x)(m_2x + b - y)}{(y - m_1x)^2} \quad (130)$$

or, evaluated for the coordinates d, e,

$$k = \frac{(e - m_3d)(m_2d + b - e)}{(e - m_1d)^2} \quad (131)$$

Upon solving equation (129) for $y = f(x)$, it is found that

$$y = Px + Q \pm \sqrt{Rx^2 + Sx + T}$$

in which

$$P = \frac{(m_3 + m_2 + 2km_1)}{2(1 + k)}$$

$$Q = \frac{b}{2(1 + k)}$$

$$R = \frac{4k(m_1m_3 + m_1m_2 - m_2m_3 - m_1^2)}{4(1 + k)} + \frac{m_2^2 + m_3^2 - 2m_1m_2}{4(1 + k)^2}$$

$$S = \frac{b[m_2 - m_3 + 2k(m_1 - m_3)]}{2(1 + k)^2}$$

$$T = \frac{b^2}{4(1 + k)^2} = Q^2$$

A formula expressing $x = f(y)$ may be developed by the same procedure.

To illustrate the development of a curve equation of type (b), expressed as $y = f(x)$, consider the following case. The maximum half-breadth, aft section, side view, of a radiator air scoop is governed by the following basic data:

$m_1 = 0.48083478$
$m_2 = 0.82040943$
$m_3 = 0.04742676$
$d = 16.12$
$e = 11.054$
$b = 12.4604806$

It is required to develop the equation of the conic section thus determined.

(*Continued on page* 316)

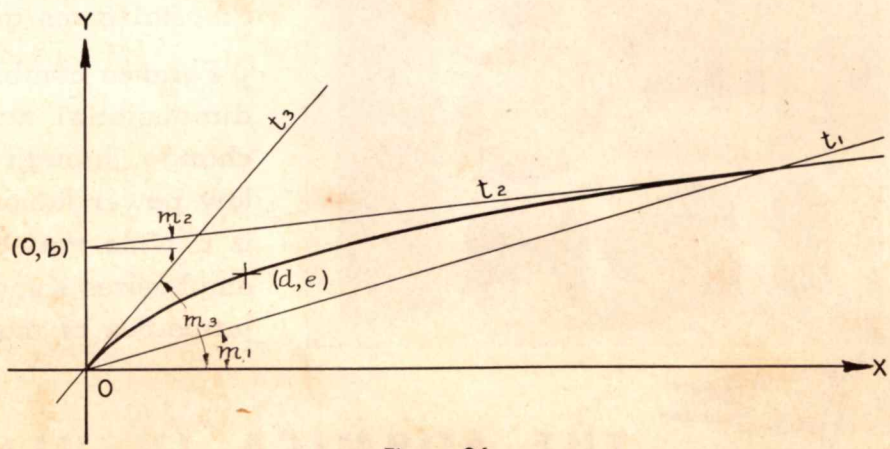

Figure 86

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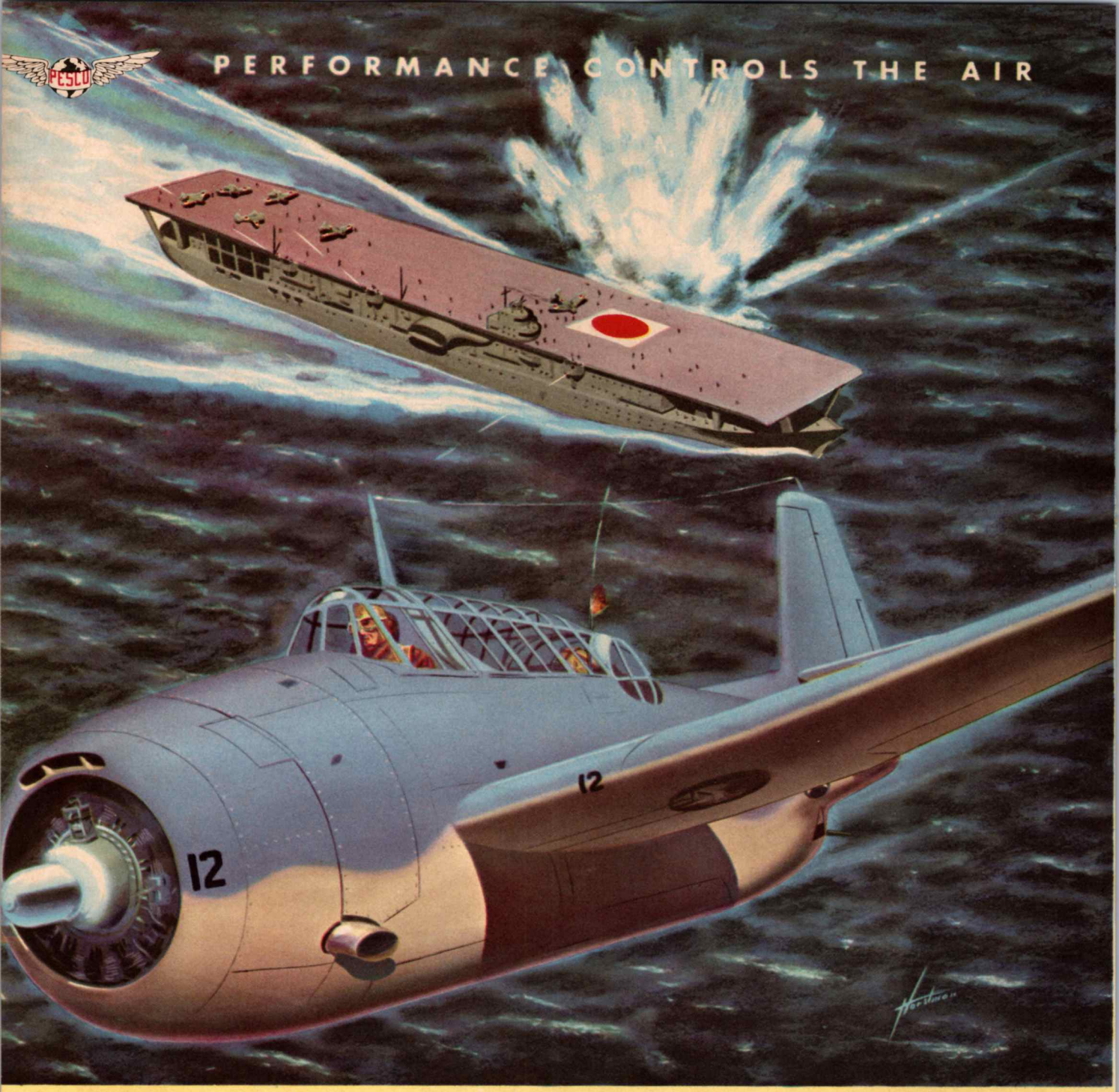
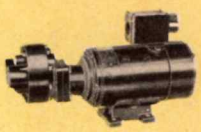


Grumman Avenger



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ARMY E NAVY

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ARMY E NAVY

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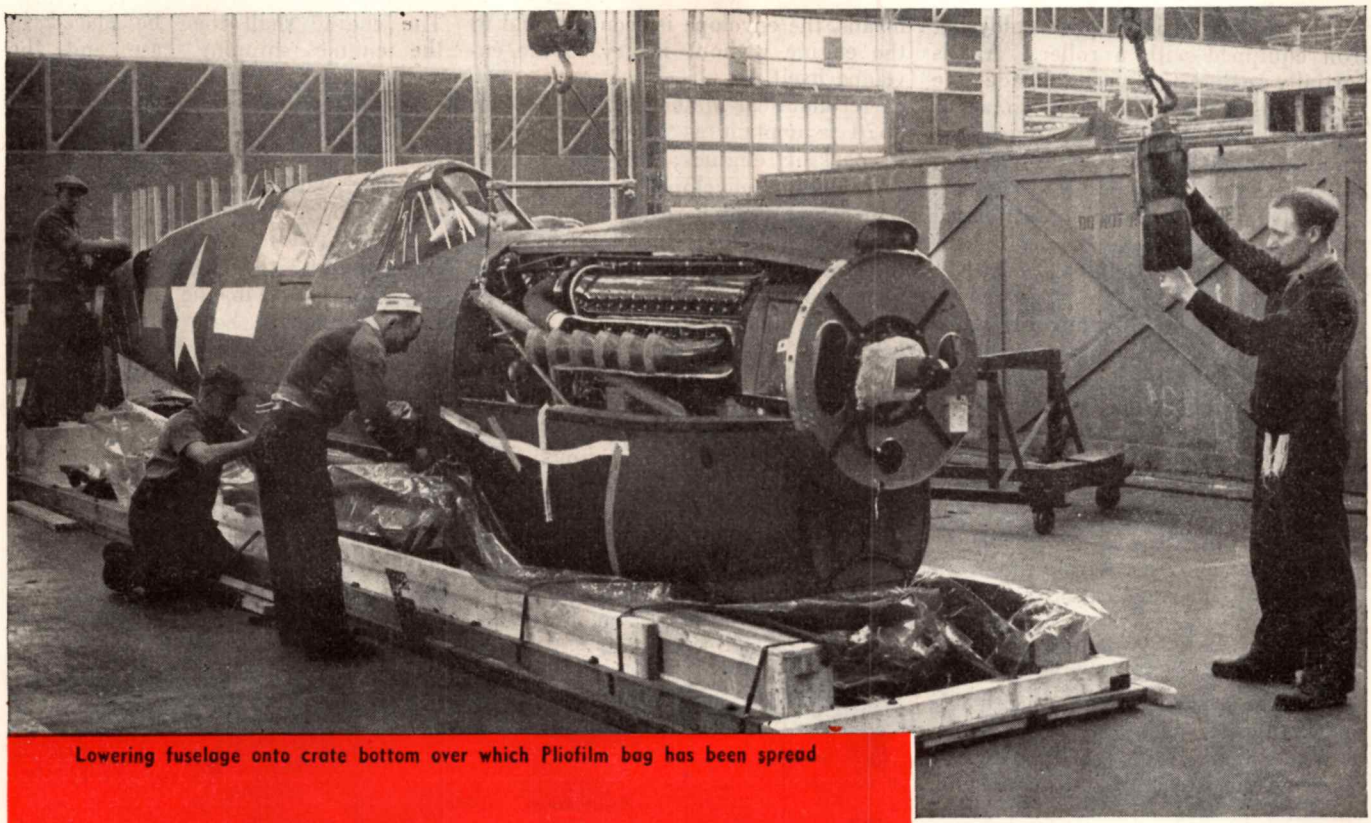


Lowering fuselage onto crate bottom over which Pliofilm bag has been spread

WRAP AIRCRAFT for OVERSEAS SHIPMENT

● In view of the climatic conditions encountered in today's far-flung battle zones—the abrasive sands of Africa, the high humidity of the jungles, the mist and rains of the Aleutians, and above all, the corrosive salt water of the oceans—protection becomes a factor of the first magnitude. Particularly is this true of aircraft which are being sent across the seven seas to our several fronts. The time-honored method of greasing and degreasing has served its purpose with varying degrees of success, but a rival has put in an appearance with the development and introduction of waterproof, dehydrated, plastic envelopes.

Pioneering in the "raincoats for airplanes" field is the Curtiss-Wright Corp. who first applied these envelopes to the *Warhawk* P-40 fighter plane for overseas shipment. These envelopes were of necessity 30 ft. long and 400 ft sq and cover the aircraft fuselage from nose to rudder. Pliofilm is the material used and this is manufactured by the Goodyear Tire & Rubber Co., Inc. The idea grew from the recently developed practice of sealing aircraft engines and engine parts in plastic bags prior to crating.

The substitution of envelopes eliminates several objectionable features inherent with the use of grease. While grease was an adequate protection for those parts so covered, the radio instruments and other items were left wholly unprotected. Removing grease in the field is never so simple as its application at the factory, for field facilities are limited at best, and on some fronts, are totally lacking. Much time is lost at best. If the weather is dry and windy, dust will adhere to coated parts.

Pliofilm "Raincoat"

Putting this protective "raincoat" on a fighter plane is a relatively simple matter. After the bottom of the fuselage box has been built and the welded iron fuselage carriage support bolted into place on the box's bottom, the 30-ft long *Pliofilm* bag is unrolled and laid flat over the floor of the fuselage box, (fig. 1). The fuselage carriage support studs are inserted through four holes provided for that purpose in the envelope and the complete fuselage and motor unit is then lowered onto the carriage support by means of an electric crane. Cardboard stiffeners are used as washers where the studs pass through the carriage supporting the fuselage. With the bolts drawn tight and securely, holding the complete P-40 fuselage section upright, the cardboard stiffeners act as self-sealing washers at the point where the bag is perforated.

After putting in about 40 lb of a dehydrating agent (fig. 2), the bag is pulled up and around the fighter airplane, and while two men seal the bag, other workmen begin installing the opposite side panel of the shipping crate. While one man overlaps the joining sections of the bag and pinches them together, another seals the seam

with heat, using an electric soldering iron equipped with a roller. Air is partially exhausted from inside the bag, using a vacuum pump so as to collapse the bag and minimize the amount of air to be dehydrated (fig. 3). Crating is then completed (fig. 4).

Goodyear's *Pliofilm* is formulated from a base of natural rubber, plasticisers and various chemicals. Used in food packaging for the past seven years, it has handled many of industry's toughest jobs. For example, weight in meat loaves, between packer and consumer, was reduced from 80% to 0.3%, by substituting *Pliofilm* for the wrappers formerly used. As this material contains about 65% natural rubber, the fact that approximately 90% of the envelope can be reused from the original aircraft package after shipping, is of importance.

Greasing and Degreasing Out

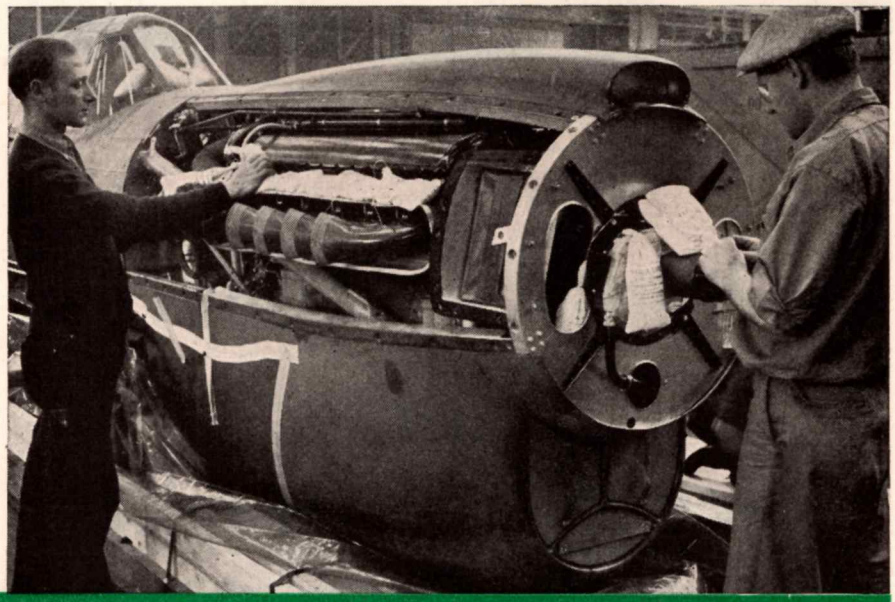
Wrapping aircraft engines with this material saves from 50 to 75 man-hours which would ordinarily be consumed in greasing and degreasing, entailing partial disassembly and assembly (fig. 5). The envelopes may be applied by one of two methods under the government specifications. They may be placed in the well of the shipping case or engine stand or, by the other method, may be applied while the engine is suspended from a hoist. After being secured in place in the latter method, the envelope is then carried with the engine to the shipping case. After being applied to an engine, the envelope is secured to it by gaskets or washers affixed to the film and through which the engine mounting bolts are inserted. The bolts are then tightened down. By this means, the envelope is securely held to the engine without injury to the envelope itself.

Aeronautical Materials Specification 2570 is explicit as to the procedure in packing engines; this states that: "An engine envelope, in conformity with AS-6, (which reads, 'transparent, moisture resistant'), shall be fitted to the shipping case saddle or anchor plate and the holes for the anchor bolts shall be punched. To hold the envelope in position, the anchor bolts may be inserted through the oil and moisture-resistant gaskets attached to both sides of the engine envelope material at each anchor bolt hole. The anchor plate or saddle, together with the envelope, shall then be fitted to the engine, taking care not to tear the envelope. The anchor plate or saddle shall then be secured to the engine by means of the engine anchor bolts. The engine shall then be placed in the engine shipping case and the anchor plate or saddle bolted to the case. This procedure may be varied at the discretion of the shipper so long as the anchor plate or saddle together with the envelope can be removed with the engine.

"The humidity indicator shall then be secured to the engine opposite the inspection port in the shipping case in a manner to be readily observed from outside the shipping case through this port. Bags of dehydrating agent, AMS 3420 Grade E, shall be distributed evenly around the periphery and the fore and aft sections of the engine. The dehydrator bags shall not be removed from their moisture-resistant shipping container until immediately before attachment to the engine."

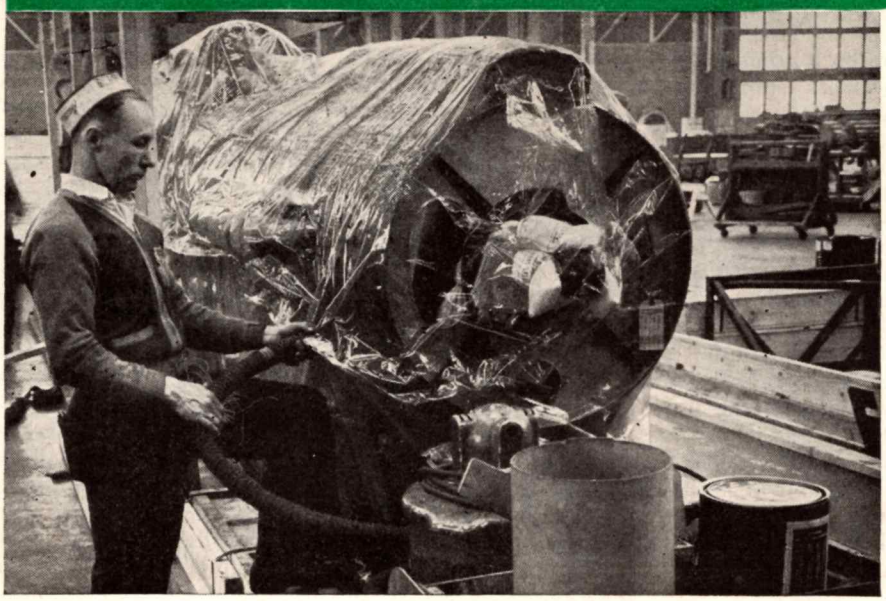
Before the envelope or bag is applied, of course, the engine has previously been prepared with silica gel, bags of the material in the cylinders, plugs in place of the spark plugs and the crank case sump plug, and a 2-oz. bag of the granules stuffed into the carburetor. Small sacks of silica gel are also distributed around the periphery of the engine, and a humidity indicator card is attached. After the envelope is unrolled upwards over the cylinders so that it extends above the engine — or the forward end of the propellor shaft, in the case of a radial-type motor—it is ready for sealing. Being thermoplastic, the *Pliofilm* bag is sealed merely by the application of heat, resulting in a welded bond impervious to moisture vapor and as strong as the envelope itself (fig. 6).

(*Continued on page* 240)



Distributing bags of dehydrating agent at specified points

Below: Partial exhaustion of air cuts necessary dehydration



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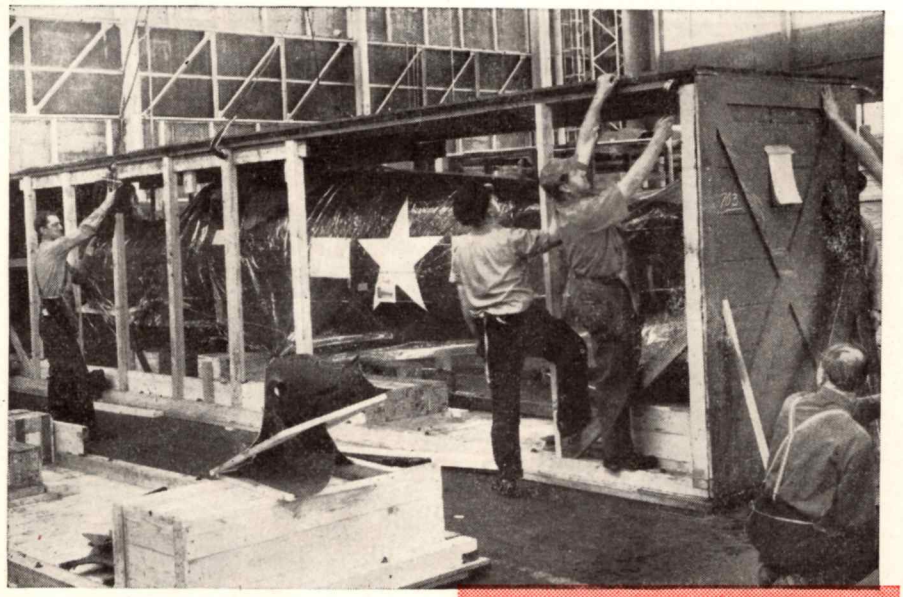
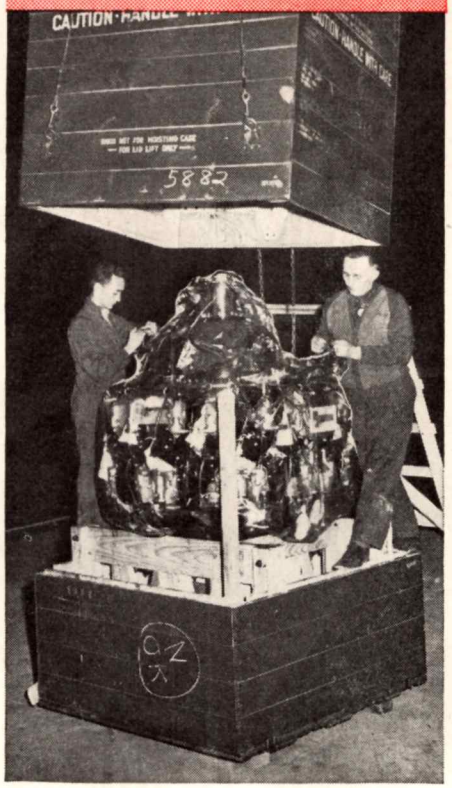


Above: Nearly-completed shipping crate being assembled by workmen

Below: Removing engine from bag which obviates greasing and degreasing



(*Continued from page* 238)

Army and Navy specifications recommend that the heat-sealing be done with an iron having a rolling contact with the film. In emergencies, however, a satisfactory seal is obtainable through use of a flat iron or hot plate—providing paper is used as an insulator between the iron and the film. Various types of heat-sealing equipment have been developed for sealing, and the cost of this type of equipment for airplane engines is about $650. Very satisfactory results are being obtained also with a hand-operated sealer which was constructed especially for heavy duty, continuous service. In addition to being suitable for its original purpose, this sealer is likewise convenient for sealing smaller bags and for patching. They cost from $15 to $25.

Use of Traveling Sealer

Heat-sealing of engine envelopes by the traveling sealer is accomplished as follows: The opening or lip of the envelope with the engine in it, is supported above the engine and held in place by clamps, care being taken to ensure that the top edges of both the back and the front panels are held evenly together. The automatic sealing unit travels across the width of the opening on a framework erected for this purpose, and the two edges of the film are sealed together by passing through heating and pressure rollers. Before a complete closure is effected, however, the air is partially exhausted. If a hand-sealing iron is used, the seal is made by placing the two edges of the bag evenly together on a flat, smooth surface board or table which can be placed astride the engine in the form of a platform. The surface of the board or table is covered with blotting paper, rubber flooring, linoleum or a similar substance.

With thermostatically - controlled sealing irons, inexperienced workers quickly learn the amount of pressure required and the correct operating speed. The sealing heat, incidentally, ranges from 325° to 350° F. After the sealing, the excess film above the engine is folded in "concertina" fashion and held in place around the propeller shaft with tape. This prevents excess movements of the film during shipment.

One advantage of *Pliofilm* for airplane engines, the Army and Navy have discovered, is in the fact that occasional tears or punctures can be repaired easily by heat-sealing a piece of *Pliofilm* over the torn area, or by merely overlapping and fusing the torn edges of the tear or puncture. The *Pliofilm* being used for airplane engine bags is of an especially-designed thickness, made by laminating two lighter gages of film of a type designed to furnish maximum resistance to transmission of moisture vapor, and to puncturing and tearing. As a result, this film is tough, flexible and easily heat-sealed. The Pratt & Whitney Aircraft Co., the Packard Motor Car Co., and others, package their aircraft engines in *Pliofilm*.

It is reported that engines have remained as long as eight months in some wrappings before the humidity had risen to the danger point, which is indicated by a humidity detector hung inside the wrapping (fig. 6). This is a card mounting cobalt-impregnated silica gel, which is deep blue when dry, but as the granules absorb moisture, they change to violet and then to pink. Fresh silica gel is then necessary. A window is left in the crate so that this indicator can be observed through the transparent wrapping, from the outside (fig. 7).

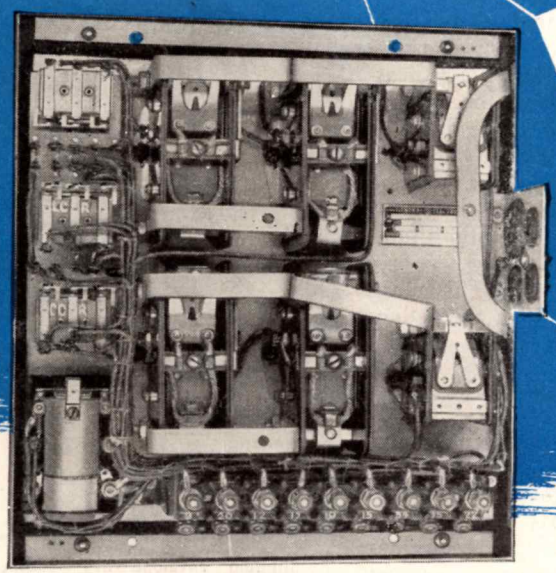
Uniform Distribution Required

The SAE specifications state that for export shipment, the dehydrating agent shall be uniformly distributed around the engine at the minmum rate of one pound per cylinder, for engines up to and including 14 cylinders. For engines with more than 14 cylinders, the recommended minimum of 14 lb shall be supplemented by the addition of dehydrating agent at the rate of at least one lb per each additional cylinder.

The most generally used dehydration agent is silica gel which got its commercial start with air-conditioning. Silica gel, a granular alumina silicate that readily absorbs moisture from the air, keeps the relative humidity of the package below 20%, whereas the U. S. Bureau of Standards has determined that there can be neither rust nor corrosion below 30% humidity. Silica gel absorbs half its weight in water without changing its own physical properties. Unlike many dehydrating agents, sodium chloride for instance, it does not go into solution when taking up water. Neither does it become wet or damp, and it has no corrosive action of its own after absorbing moisture. This is extremely important. This material can be reactivated (dried out) and used over and over again, almost without end.

(*Continued on page* 242)

G.E. Announces



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Engine heaters
Engine starters
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GENERAL ELECTRIC

676-92-8940

(*Continued from page* 240)

Also extensively used in packaging aircraft and aircraft engine parts, etc., are a number of wrappings developed by various concerns and incorporating the cellulose acetate-base materials produced by du Pont, and by the Celanese Celluloid Corp. A novel use to which cellophane has been put, is the packaging of frosted airplane rivets between the "cooler" and riveter, an innovation of the Consolidated Aircraft Vultee Co., San Diego. Duralumin rivets, heated to 900° F., quenched and cooled to —45° F., will maintain their softness just so long. Therefore, they must be doled out constantly to the many riveters in small quantities. Even so, many lots require room temperature and hardness, before they can be used, necessitating a great amount of re-sorting, re-heating, and re-cooling.

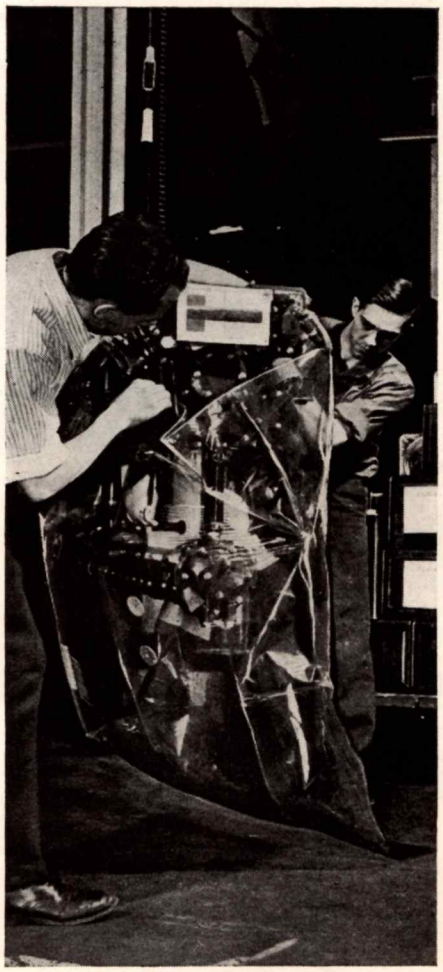
Rivets in Cellophane Bags

An important saving in this respect is made by sorting the cold rivets as to size and placing them in cellophane bags as they are removed from the quench. A filling machine, very much the same as that used to put rice or beans into cellophane bags, is used in one plant and only one or two ounces of rivets go into each bag. After the bags are loaded, they are crimp sealed and move into the storage machine which reduces the temperatures of the load of rivets to —45° and holds it there indefinitely. As the rivets are needed, they are transferred to portable low temperature cabinets which are wheeled to the rivet stations on the bomber assembly line. Since the cellophane acts as an insulation, and the bags are removed only one or two at a time, the rivets are kept in drivable condition much longer than when bags were not used. The riveter can take up to an hour to use the rivets, which is an increase of 100%. Twisting the top of the bag shut when not in use is a help in extending the drivable life of the rivet. Because of the transparency of the cellophane, the operator can readily pick out the proper size rivets.

This practice, we understand, has greatly reduced the number of rivets which have to be returned for re-heating, and has also cut down the amount of re-sorting. In one large bomber plant, where the driving time had been increased from a half hour to one hour, re-sorting for size has been cut from 15,600 to 600 lb per month, and the accompanying waste has been reduced from 40% to 1½%. This plant saved $7500 per month on the reduction of sorting to size alone.

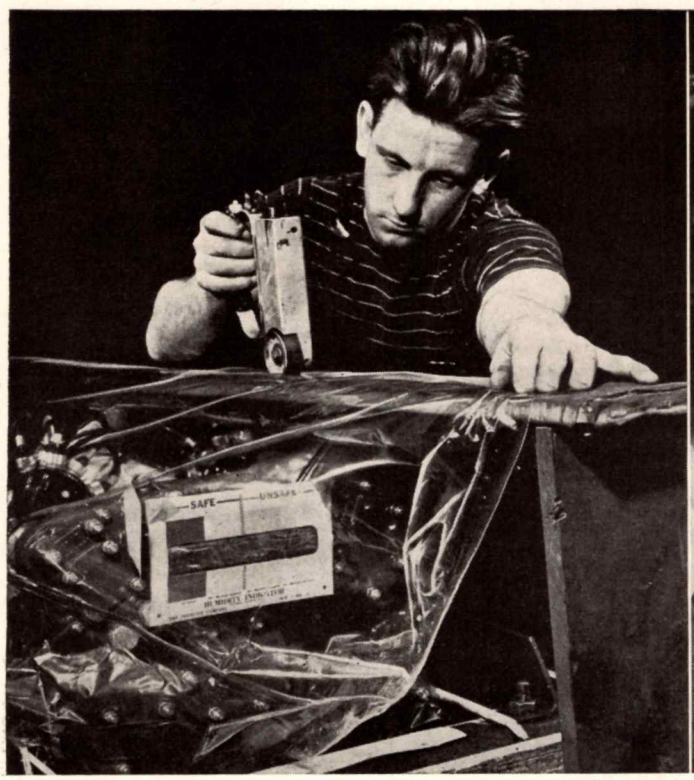
Handling of Small Parts

Cellophane bags are used in a number of aircraft plants and factories making aircraft parts for keeping bolts, rivets, and small parts separated in the storerooms and along the production lines. Their transparency greatly expedites the handling of these small parts and generally speeds up the work.

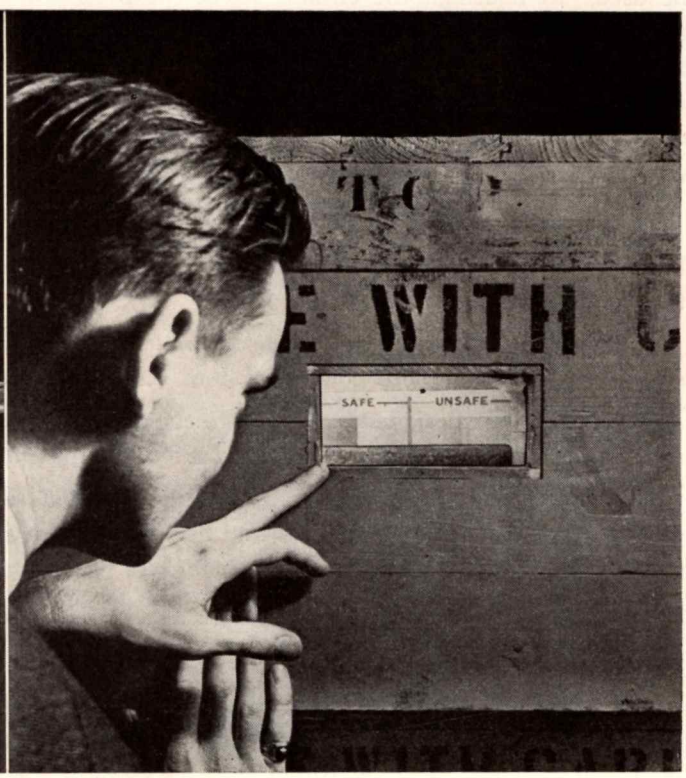


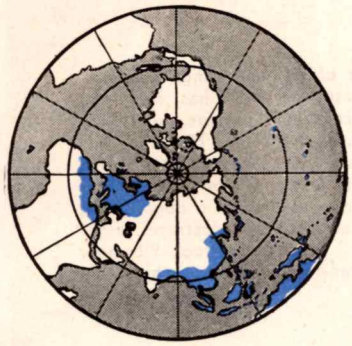
Slipping envelope over engine suspended from above is simple operation

Heat sealing bag with hot unit makes air-tight package



Humidity indicator card must show through window in crate

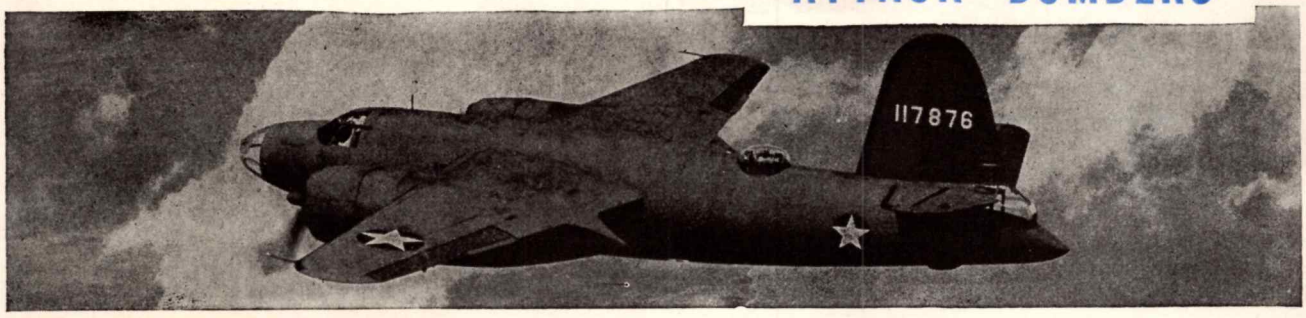




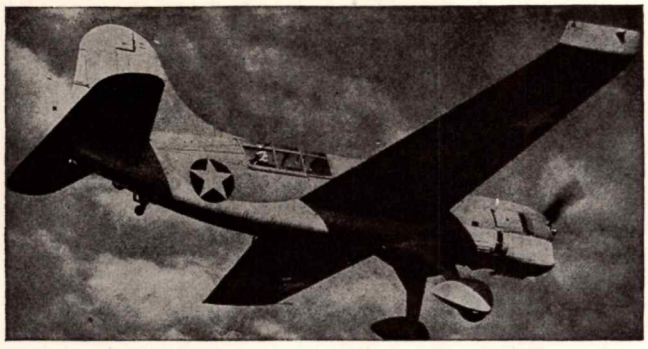
Serving over EVERY FRONT

and behind the lines for Victory!

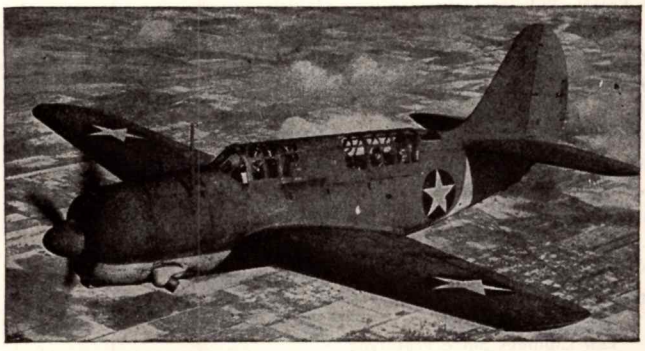
Hyland-equipped aircraft of many leading manufacturers are now on active duty in the combat areas shown on map (left), and at training fields here and abroad. This is the second in a series of advertisements presenting Hyland-equipped **ATTACK BOMBERS**



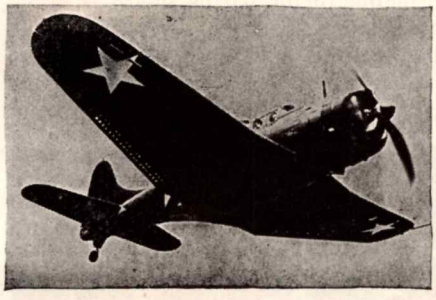
ONE OF THE FASTEST and most versatile medium bombers is the Hyland-equipped MARTIN B-26, used successfully in attack on many fronts. Combined bombing, fighting and strafing power made it a formidable weapon in the winning of Tunisia.



"THE SEAGULL" two-place, CURTISS monoplane is for catapult launching at sea or for long range patrol from land. It carries bombs or depth charges for long-range submarine attacks.

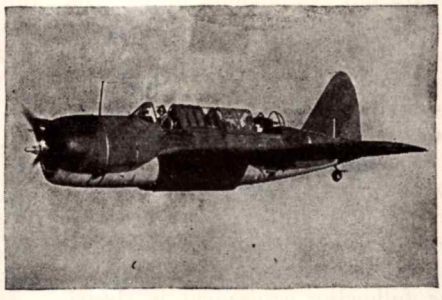


LARGER BOMB LOADS are carried faster and farther by this CURTISS "Helldiver" than by any other single-engine dive bomber now in service, according to its designers . . . and operates from carrier or land bases.



ON THE ATTACK, this Navy dive bomber, the DOUGLAS "Dauntless," plays havoc with Axis forces. It is one of the deadliest bombers in combat service. Note brake flaps silhouetted as it rises to battle (left).

BRITISH dive bombing on enemy objectives is effectively carried out by the well known American-made BREWSTER "Bermuda". The Hyland-equipped "Bermuda" (right) is shown in full war paint.



Hyland employees are proud of this flag. It displays the united loyalty of every worker.

Since 1928 aircraft parts have been our business . . . from the very first, when The Hyland Machine Company was organized to serve the Army Air Corps, we have specialized in aircraft control parts. You will find our manufacturing facilities and unusual service worth investigating. Phone, write or wire today for the new Hyland Catalog.

HYLAND MACHINE COMPANY

DAYTON, OHIO

HMC

Because of its long range and airworthiness the P-38 has been the most versatile American fighter to enter combat to date. The plane has been used not only for interception of enemy bombers—for which it was designed—but also as a dog fighter, ground strafer, tank destroyer, night fighter, medium attack bomber and long-range photographic ship

THE ELECTRICAL SYSTEM OF THE P-38

● It would have been considered unthinkable, before the advent of the Lockheed *Lightning*, for a single-place airplane to weigh as much as a 10-passenger transport. The P-38 tips the scales at more than did the old 3-engined Ford, yet its compactness reconciles its weight with the airworthiness and control qualifications which have distinguished this plane as one of the world's top-notch fighters.

Compactness is even more a feature of the *Lightning's* electrical system than of any other part of its design—the instruments, controls, radio and other electrical equipment it carries being equivalent to those installed on a 20-passenger transport.

Few Changes Since Prototype

The P-38's electrical system has been altered but little since the engineering was completed on its prototype some five years ago. No changes in the original arrangements were made until the 9th and 10th models of this plane, in the summer of 1942. Nor do any of the subsequent five models embody modifications of consequence. The electrical system comprises a 24-v d-c single wire installation, except for the 115-v and 26-v 400-cycle a-c used for fluorescent lighting and the remote compass.

The following equipment is electrically operated: the automatic oil and coolant system, intercooler actuators, starters, turbo-supercharger regulators, temperature indicators, propellers, fuel level indicators, auxiliary fuel pumps, tachometers, remote compass, bomb and tank release, and armament firing. The lighting and miscellaneous warning devices are also electrically operated.

Wiring is protected by rigid, flexible and plastic conduits with a marked trend toward the elimination of all conduit to facilitate production and maintenance. This trend has been stimulated by Vega's experience in the wiring of the B-17.

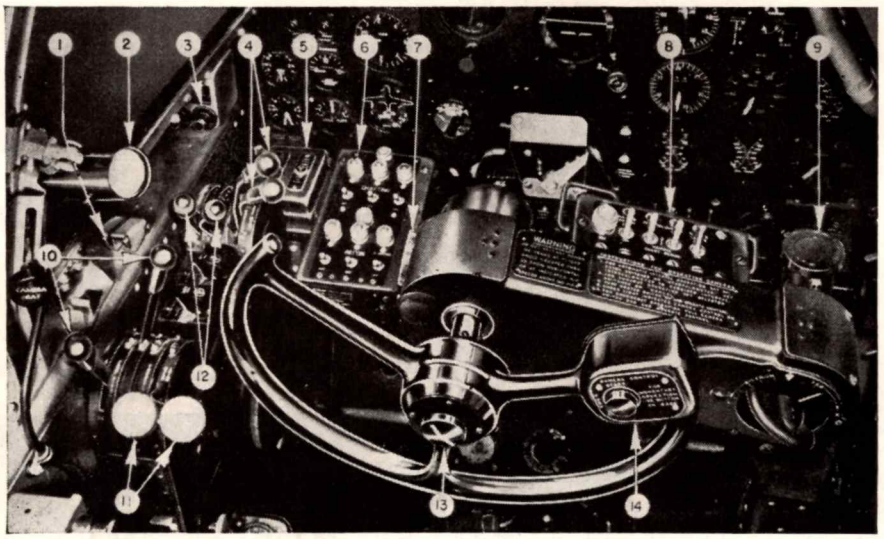
The use of harnesses in place of conduits, either fixed or flexible, presents a number of advantages from a manufacturing and airplane weight standpoint. It not only saves aluminum tubing, but the labor involved in its procurement, storing, handling, cutting and bending. Furthermore, conduit must be installed in the airplane and the wires pulled through it in the crowded space of the fuselage.

By use of open wiring the weight of the conduit is eliminated and the time necessary for the wiring of the aircraft is cut down considerably. In the case of a direct hit by shrapnel or a bullet, the open wire circuits are easier to repair than the conduit type.

New Wiring Board Technique

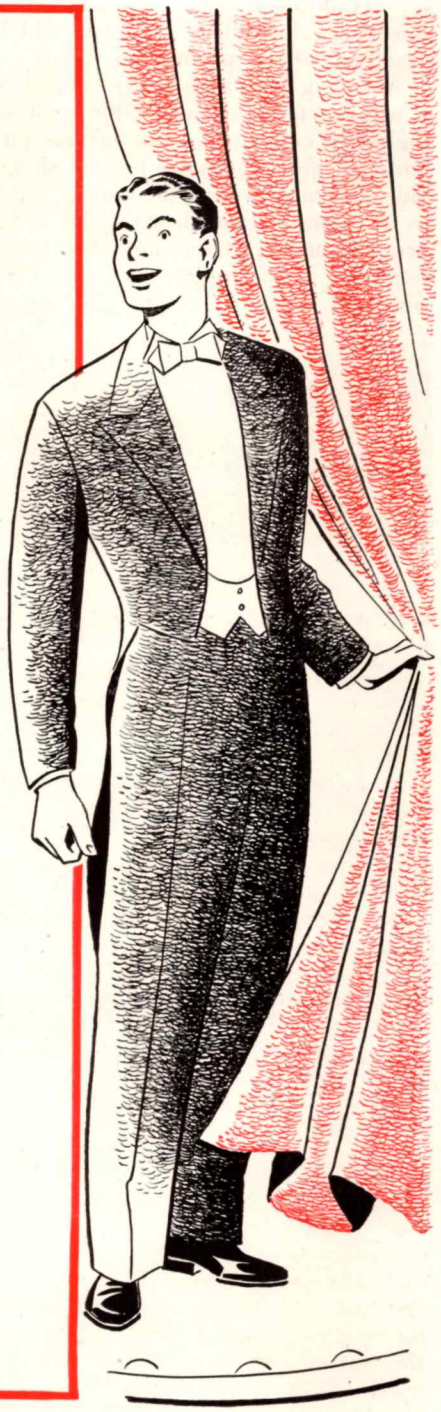
In line with the industry's quest for greater speed even in the more minute operations of aircraft sub-assembly, Vega has found a way to use the wiring board in a more efficient manner than ever before. Although the basic principle of the wiring board is by no means new, there are several outstanding features and improvements which

(*Continued on page* 246)



Cockpit control switches: 1. propeller feather switches; 2. flexible cockpit light; 3. propeller warning lights; 4. coolant flap controls; 5. propeller safety switches; 6. camera indicator box; 7. fluorescent lamp; 8. camera control box; 9. fluorescent lamp; 10. propeller pitch controls; 11. throttles; 12. mixture controls; 13. microphone button; 14. camera operating button

Is there a watchmaker in the audience?



★ To the average person, there's probably nothing startling in the appearance of most aircraft fittings. But, someone who has worked with intricate metal parts—say, a watchmaker—would see unusual things in AFCO Fittings.

He would notice that the threads are as clean and sharp as a hound's tooth, free from the chaser marks which betray hurried production . . . that the noses are smooth as glass, not marred by careless clamping into machines.

Raising an AFCO Fitting to his eye, he would discover inside holes are perfectly reamed, concentric to outside threads by a few thousandths. Perhaps the mirror finish would take his eye, too, for AFCO Fittings are not only exactingly Anodized, but also handled and packed to avoid scratching this protective coating—even to the capping of all "AN" parts with paper thread guards, and separation of layers by special spacers to prevent cutting, nicking and formation of burrs in shipment.

Yes, if there's a watchmaker in the audience, he'll say you are getting fine fittings if yours are AFCO Fittings.

AFCO *Fittings*

ARMY E NAVY

NEW "AN" TUBE, PIPE AND HOSE FITTINGS

FITTINGS OF QUALITY FOR PLANES OF WAR AND PEACE

The Aircraft Fitting Company • 1400 East 30th Street • Cleveland, Ohio

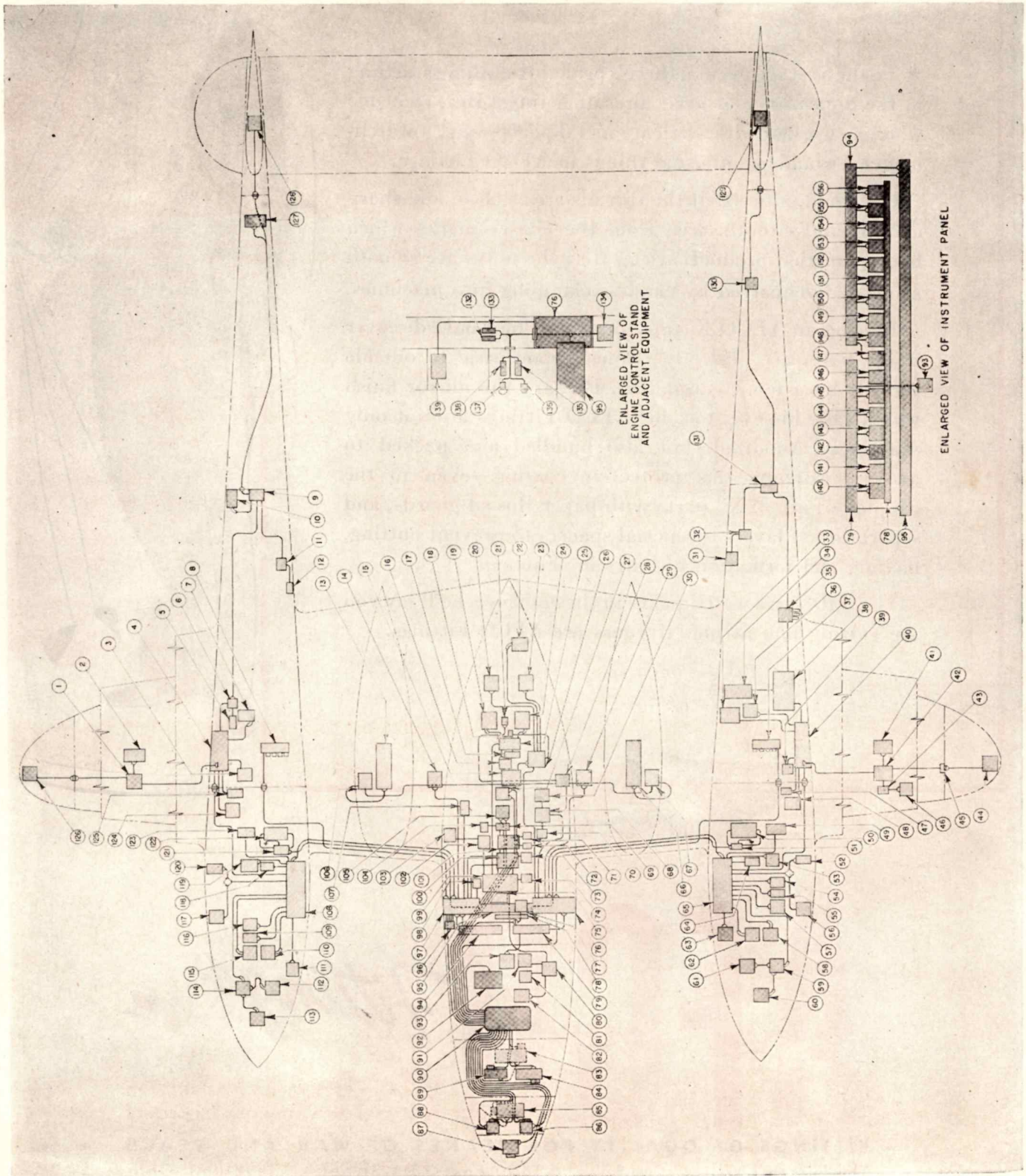
(*Continued from page* 244)

have been introduced at Vega which greatly facilitate production.

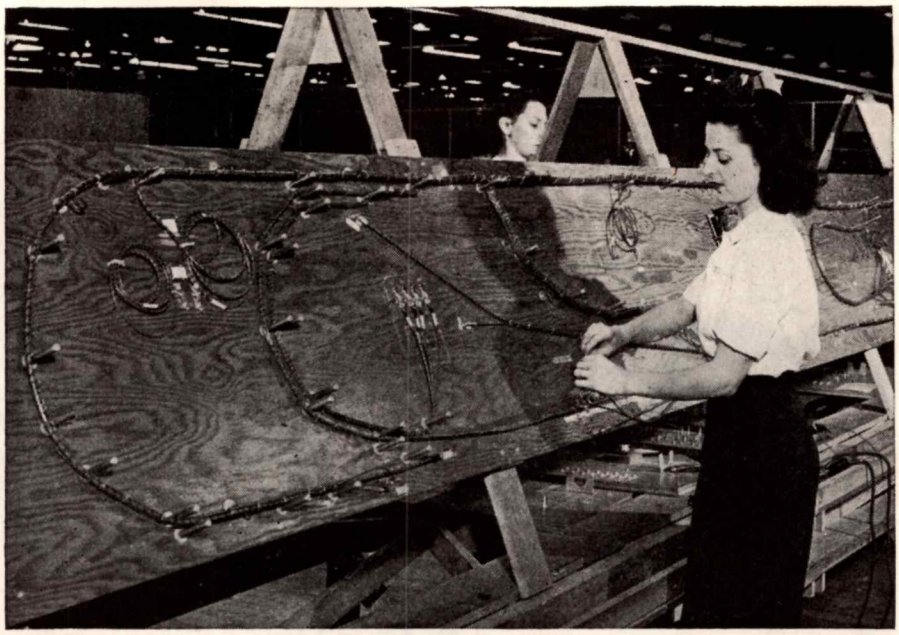
A wiring board generally comprises a wooden table on which the path of the wires constituting the various circuits is traced. Posts are located alongside the trace to keep the wire in place as it is laid on the board. The wires are laid one at a time and then laced together. The complete assembly thus obtained consttitutes a harness which

Key to Electrical System

1. Landing Light Junction Box; 2. Landing Light; 3. L.G. Down Position Switch; 4. Fillet Junction Box; 5. L.G. Up Position Switch; 6. L.G. Up Position Switch Junction Box; 7. L.G. Position Transmitter; 8. Autosyn Transmitter Box; 9. Inverter Junction Box; 10. Inverter; 11. L.G. Up-Lock Junction Box; 12. L.G. Up-Lock Switch; 13. Bomb or Tank Shackle; 14. Front Fuel Tank Transmitter; 15. Landing Gear Warning Horn; 16. Free Air Temperature Bulb; 17. Downward Recognition Lights; 18. Upward Recognition Lights; 19. R.H. Auxiliary Fuel Pump; 20. R.H. Rear Fuel Tank Transmitter; 21. Cross Feed Valve; 22. Flap Position Transmitter; 23. L.H. Rear Fuel Tank Transmitter; 24. L.H. Auxiliary Fuel Pump; 25. Fuel Pump Junction Box; 26. Rear Fuel and Flap Junction Box; 27. Reconnaissance Intervalometer; 28. Fuselage to Wing Lower Fillet; 29. Front Fuel Tank Transmitter; 30. Fuel Pump Switch Box; 31. L.G. Up-Lock Switch; 32. L.G. Up-Lock Switch Junction Box; 33. L.G. Scissors Switch; 34. L.G. Up Position Switch; 35. Battery Cart Plug; 36. L.G. Position Transmitter; 37. Autosyn Transmitter Box; 38. Voltage Regulator Junction Box; 39. L.G. Down Position Switch; 40. Fillet Junction Box; 41. Landing Light; 42. Landing Light Junction Box; 43. Wing Rib Station 218; 44. Wing Tip Light; 45. Wing Tip Junction Box; 46. Pitot; 47. L.G. Throttle Switch; 48. L.G. Down Lock Switch; 49. Distributor; 50. Dual



Magneto; 51. Magneto Junction Box; 52. Carburetor Temperature Bulb; 53. Fuel Pressure Warning Switch; 54. Prestone Temperature Bulb; 55. Oil Temperature Bulb; 56. Oil Dilution Solenoid Valve; 57. Generator; 58. Oil Cooler Flap Transmitter; 59. Propeller Relay Box; 60. Propeller Motor; 61. Propeller Governor; 62. Oil Cooler Flap Motor; 63. Prestone Warning Switch; 64. Starter; 65. Engine Junction Box; 66. Bomb or Tank Shackle; 67. Wing Junction Box; 68. Cockpit Light and Bomb Control Box; 69. Microphone Switch Box; 70. Auxiliary Cockpit Light; 71. Fluorescent Light; 72. Fluorescent Light; 73. Propeller Filter Box; 74. Nose Up Position Switch; 75. Oxygen Warning Light; 76. Main Junction Box; 77. Camera Blinker Box; 78. Instrument Panel (See Enlarged View); 79. Instrument Junction Box; 80. Nose Junction Box; 81. Nose Down Position Switch; 82. Nose Position Transmitter; 83. K-18 24" Reconnaissance Camera; 84. L.H. K-17 24" Reconnaissance Camera; 85. K-17 12" or 24" Reconnaissance Camera; 86. L.H. K-17 6" Charting Camera; 87. K-17 6" Charting Camera; 88. R.H. K-17 6" Charting Camera; 89. R.H. K-17 24" Reconnaissance Camera; 90. Nose Camera Junction Box; 91. Nose Down Lock Switch; 92. Battery; 93. Camera Air Temperature Bulb; 94. Instrument Junction Box; 95. Main Switch Box; 96. Inverter Auxiliary Box; 97. Main Junction Box; 98. Radio Junction Box; 99. Main Fuse Box; 100. Control Column Junction Box; 101. Control Column Switch Box; 102. Nose Up-Lock Switch; 103 Oxygen Pressure Signal; 104. Camera Trigger Switches; 105. Charting Intervalometer; 106. Wing Junction Box; 107. Cockpit Light and Recognition Switch Box; 108 Engine Junction Box; 109. Oil Temperature Bulb; 110. Oil Cooler Flap Transmitter; 111 Prestone Temperature Warning Switch; 12 Propeller Governor; 113. Propeller Motor; 114 Propeller Relay; 115. Oil Cooler Flap Motor; 116. Prestone Temperature Bulb; 117. Oil Dilution Solenoid Valve; 118. Starter; 119 Fuel Pressure Warning Switch; 120. Carburetor Temperature Bulb; 121. Magneto Junction Box; 122. Dual Magneto; 123. Distributor; 124 L.G. Down Lock Switch; 125. Throttle Switch; 126. Wing Tip Light; 127. Remote Compass Transmitter; 128. Tail Light; 129. Tail Light; 130. Battery Junction Box; 131. Tail Light Junction Box; 132. R.H. Propeller Feathering Switch; 133. L.H. Propeller Feathering Switch; 134. Propeller Warning Light Box; 135. R.H. Propeller Selector Switch; 136. L.G. Horn Silencing Push Button; 137. L.G. Warning Light; 138. L.H. Propeller Selector Switch; 139. L.G. Locking Solenoid; 140. Camera Ambient Temperature Indicator; 141. Fuel Pressure Warning Lights; 142. Landing Gear and Flap Position Indicator; 143. Oil Cooler Flap Position Indicator; 144. Front Fuel Level Indicator; 145. Rear Fuel Level Indicator; 146. L.H. Prestone Temperature Warning Light; 147 R.H. Prestone Temperature Warning Light; 148. Free Air Temperature Indicator; 149. Carburetor Air Temperature Indicator; 150. Tachometer Indicator; 151. Manifold Pressure Indicator; 152. Prestone Temperature Indicator; 153. Oil Temperature Indicator; 154. Oil Pressure Indicator; 155 Fuel Pressure Indicator; 156. Remote Compass Indicator



Wiring boards at Vega speed aircraft production by enabling operators to assemble several harnesses simultaneously. Being nearly vertical, they are used with ease and facility even by inexperienced women operators

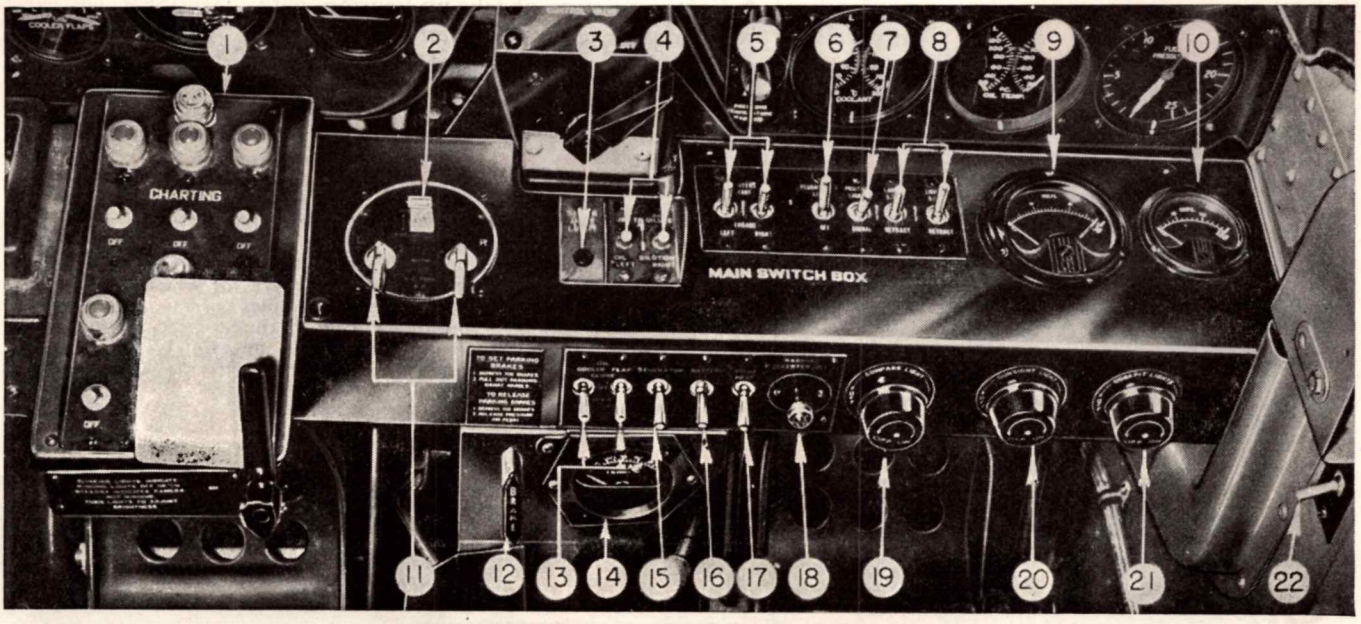
is ready for installation in the airplane.

The wiring boards at Vega have been so designed as to permit the simultaneous assembly of several "harnesses." This permits a better labor load distribution and a maximum utilization of the assembly board. Small harnesses have the advantage over larger ones in that they permit easier replacement in case of damage.

Some of the boards are used not only for assembling but also as test boards for checking the continuity and resistance of the circuit, so that no wiring errors develop. The wires used are continuously coded by means of a printing roller through which the electric wire is run prior to assembly.

Another feature of these boards is that they are placed at an almost vertical angle with consequent saving in floor space and convenience in wiring.

Main switch box: 1. Camera indicator box; 2. master electrical switch; 3. spare compass light; 4. right & left dilution switches; 5. right & left starter switches; 6. fluorescent light switch; 7. position lights switch; 8. right & left landing light switches; 9. voltmeter; 10. ammeter; 11. ignition switch; 12. brake handle; 13. oil cooler flap switches; 14. free air temperature indicator; 15. generator switch; 16. battery switch; 17. pitot switch; 18. inverter warning light; 19. compass rheostat; 20. gunsight rheostat; 21. cockpit light rheostat; 22. inverter switch



"Aero-Seal"

THE *Full* LINE OF

Approved

HOSE CLAMPS

AERO-SEAL Hose Clamps *stand alone* in meeting the new Army and Navy requirements for extra large diametral take-up. Other outstanding features include: ● High strength. ● Uniform peripheral tightening to stand high pressures without leakage. ● Self-locking, no lock wire necessary. ● No loose parts. ● Will not distort or collapse thin wall tubing. ● Can be installed or replaced without removing hose. ● Compact design of take-up housing, with no excessive protrusions. ★ *Exhaustive tests have proved the unquestioned superiority of AERO-SEAL Hose Clamps for all types of aircraft service.*

NOW! SMALL SIZES

Newest additions to the AERO-SEAL line include clamps for ¼", ⅜", ½", ⅝", and ¾" I.D. hose. Tighten an AERO-SEAL clamp on your finger or forearm and see how uniform the pressure is!

Specially good for

SELF-SEALING HOSE

This illustration shows one size of AERO-SEAL Hose Clamp applied to two different sizes of self-sealing hose. The clamp is the same size in each case and the hoses are ⅝" and 1" I.D. The extra-long take-up of AERO-SEAL Hose Clamps makes them particularly well adapted for dependable service on the soft, thick walls of self-sealing hose. On periodic inspection, a quick twist of the thumbscrew is all that is needed to insure maintenance of a leak-proof joint.

WIDE CLAMPING RANGE

AERO-SEAL Hose Clamps have *more than double* the diametral take-up required to cover variations in hose diameter, wall thickness, and the flow of rubber under repeated tightening of clamps in service. This extra take-up gives a wide clamping range . . . each size of clamp will fit several smaller hose sizes, in addition to the nominal size for which each is made. AERO-SEAL construction consists of a band perforated with holes corresponding to worm gear teeth, this band being drawn through a housing by turning a thumb-screw worm. Enough extra perforations are provided so that the clamp can be taken up *a full inch on diameter.* This will help to solve those service problems that arise when exactly the right size clamp is not in stock.

WRITE FOR NEW CIRCULAR....

AIRCRAFT Standard PARTS CO.

Aircraft Standard Parts Co.

1713 Nineteenth Avenue, Rockford, Illinois

Control for Conservation of Aircraft Materials

● The Army Air Forces and the Navy Bureau of Aeronautics are further strengthening their conservation administrative sections and field organizations by putting into immediate effect a program to conserve materials, manpower, and production facilities. This particular program is to be affected by promoting the greater utilization of more efficient and more economical methods in the manufacture of aircraft and accessories, and has the joint backing of the Army Air Forces, Navy Bureau of Aeronautics, and the Aircraft Resources Control Office, Aircraft Production Board-WPB. In cooperation with the aircraft industry, bulletins will be issued to detail the execution of the program and to describe outstanding developments which result in appreciable conservation of materials, manhours, and machine hours.

As indicated by the chart, the work to be done by the AAF and the Navy Bureau in connection with this program will be largely accomplished through the respective field organizations. The activities of both the Army and Navy Air Services have been decentralized insofar as is practicable, and additional responsibilities including more active participation in conservation programs have been assigned to these groups. These field organizations are the points of contact between the aircraft contractors and the staff organizations of the AAF and the Navy Bureau of Aeronautics.

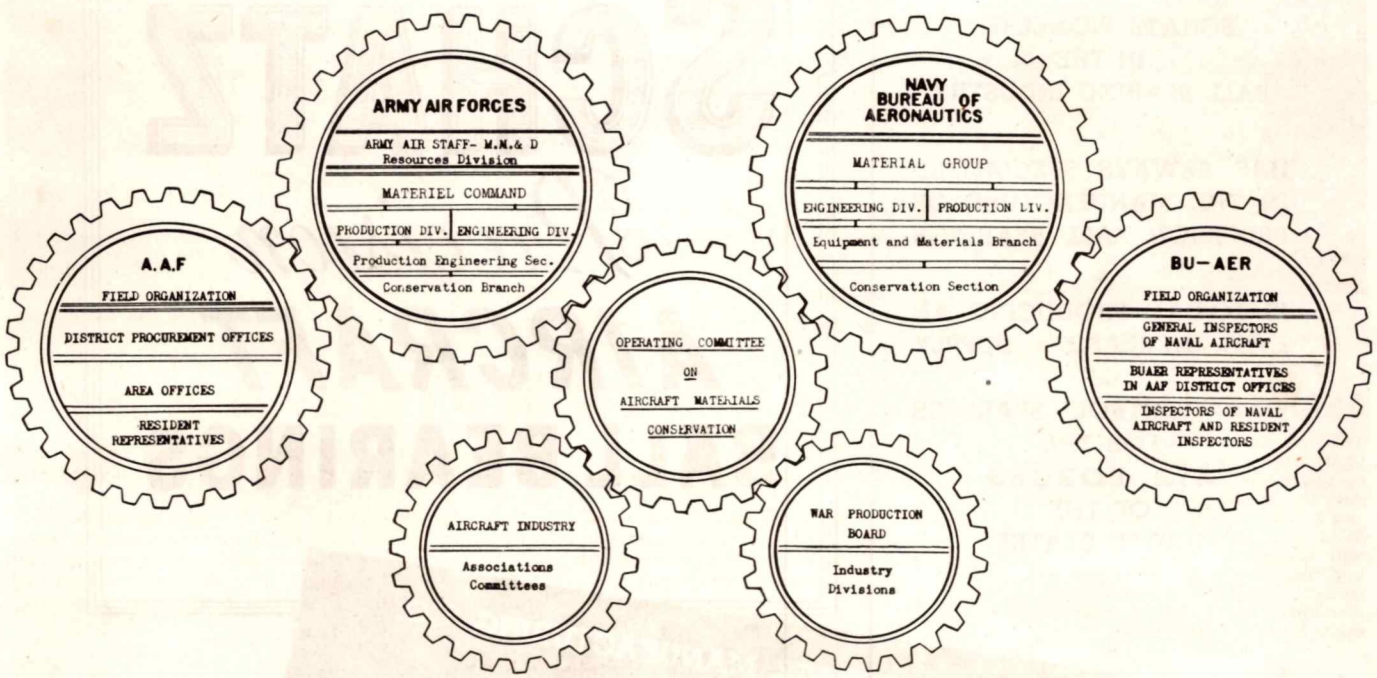
AAF Field Organizations

The field organizations of AAF consist of six Procurement Districts operating under the Commanding General, Materiel Command, Wright Field. The Procurement District headquarters are located in New York, Detroit, Wichita, Los Angeles, Chicago, and Atlanta. Within these districts, area offices have been set up and, in addition, resident representatives are located in many aircraft plants. The field organization of the Navy Bureau is headed by the offices of the General Inspectors of Naval Aircraft which are located in Los Angeles, New York, Dayton, and Ottawa. The Bureau of Aeronautics has also assigned representatives to the six procurement offices of the AAF for cooperative and integrated action on joint problems.

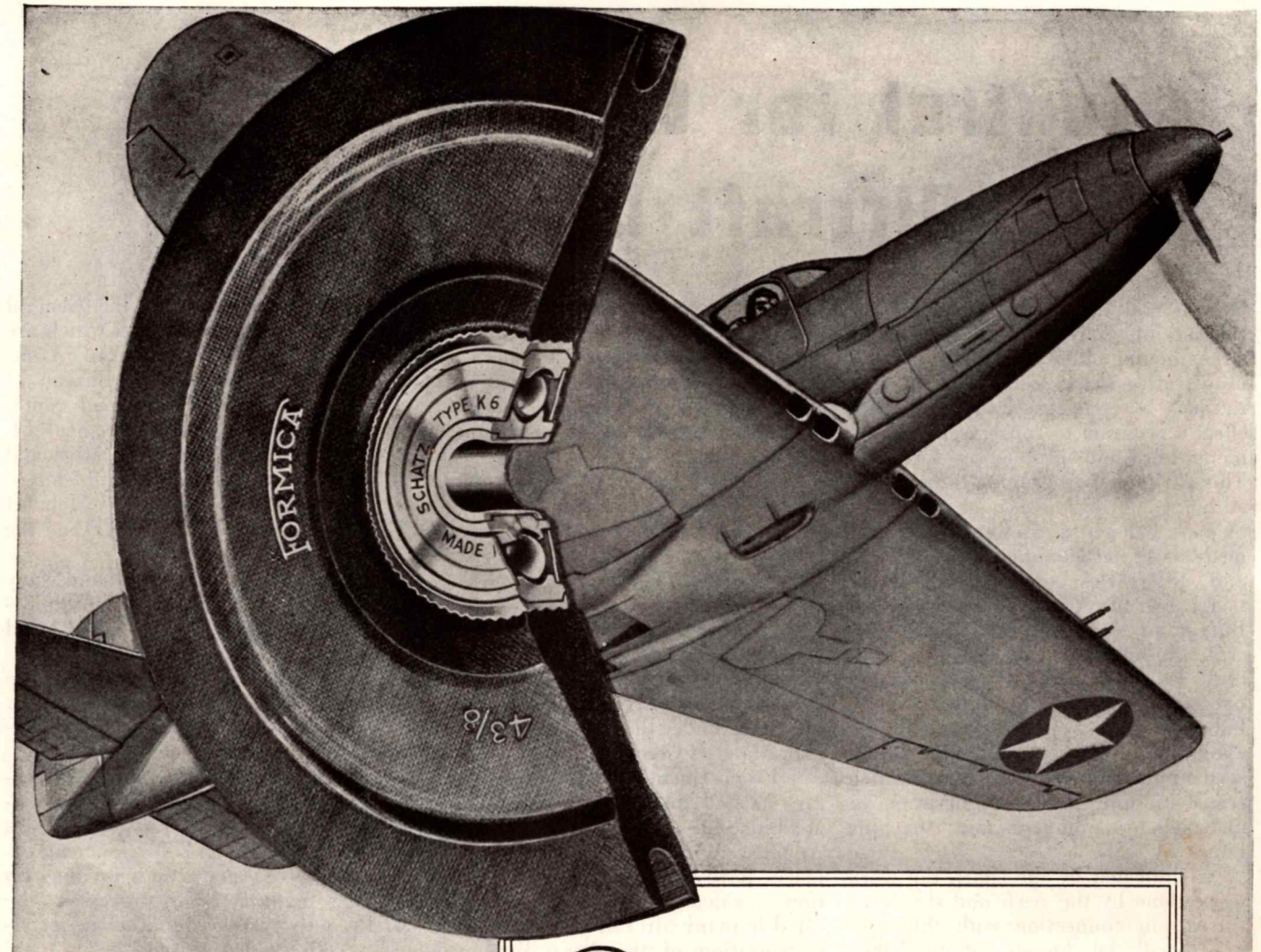
The Resources Div. and Materiel Group respectively of the AAF and the Navy Bureau will:

1. Organize and direct AAF and Navy Bureau programs designed to develop and utilize more economical manufacturing processes.
2. Cooperate with aircraft industry on problems relative to development and introduction of improved material processing methods.
3. Encourage and facilitate the exchange of information and assistance between aircraft contractors and research and development organizations and groups working on new manufacturing processes.
4. Procure outside engineering, metal-

(*Continued on page* 463)



Organization setup by which coordinated action of the various units of the AAF and Navy Bureau of Aeronautics is brought to bear on program to replace manufacturing processes resulting in excessive waste of materials, manpower and facilities with more efficient and economical methods. This is to be accomplished in part by encouraging the use of castings—permanent mold, die, centrifugal and sand; stampings—blanked, drawn and press-formed; heading and upsetting; hot pressing; pre-formed materials; tubes; extrusions and rolled sections; welded assemblies and other high economy methods. Related questions follow: Can a standard part or material be used instead of a special? Can savings be effected through re-design; two or more parts made in the place of one piece; feeds be increased; dies re-designed to induce slug weight; multiple spindle processes used; tolerances reduced or powder metallurgy employed? etc.



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Precision

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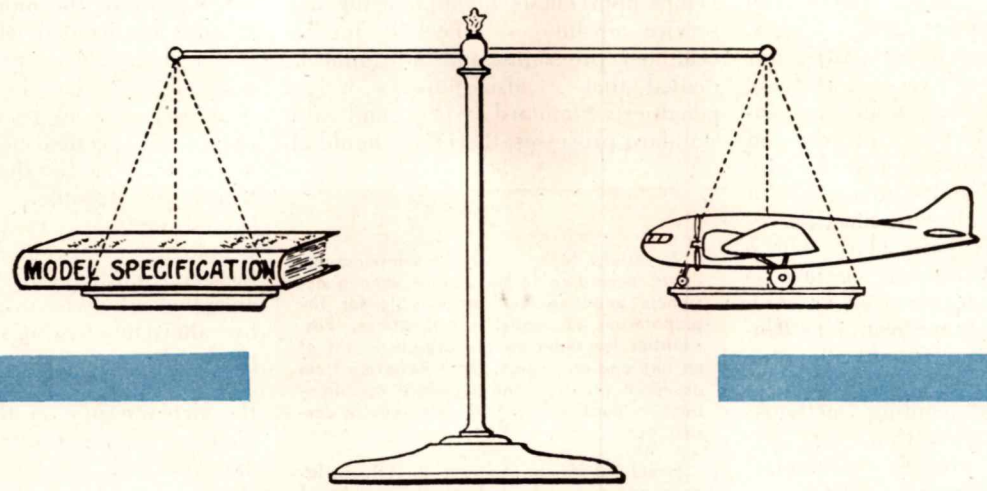


Weight Control in Specification Writing

PART I*

JOHN E. AYERS, SR.
Charter Member, Society of Aeronautical Weight Engineers, Inc.

● While the possibilities for weight control in specification writing are unlimited, there are some applied and tested means for effecting weight economy, as evidenced by airplane designs, that should be considered during the preparation of any model specification. An article of this nature, however, is necessarily limited to generalities. While many items presented herein may appear to involve airplane design more than specification writing, the fact remains that the design of the airplane is crystallized during the preparation of the model specification. Therefore, weight control must be effected during this early stage of aircraft design.

The sequence of subjects herein parallels the order and breakdown set forth by controlling agencies in their literature directing the preparation of airplane manufacturers' model specifications. Thus this paper may be used as a checking device with which the designer may determine whether or not optimum initial weight control has been achieved.

The applicable specifications controlling the design and manufacture of the airplane must be complied with to a major extent. Engineering and manufacturing progress are too rapid, however, to permit the controlling specifications to be kept up to date. Adhering religiously to all applicable specifications in every detail may serve to fetter aeronautical progress. For a new design to excel current airplines it's engineers must be bold enough to defy conventions and specifications, but at the same time, they must prove that any deviations they make are safe, practical, and desirable.

This is recognized by the controlling agencies who are anxious to analyze proposed deviations with the idea of furthering aeronautical development.

The type of the airplane largely determines the latitude available for outstanding weight control and for deviations from current practice and specifications. The larger airplanes, of course, present greater opportunities for design ingenuity and fuller utility of sizes. There are, however, ample opportunities for weight economy in the smaller airplanes.

Multi-purpose designs, where attempts are made to evolve an airplane that will meet the requirements of several types, are usually bogged down by many compromises that defeat weight economy. Airplane balance and stability are often more seriously affected. So often has this occurred that a stipulation should be made that the design and manufacture of the airplane shall meet the requirements of only one type. Only by strictly adhering to single type requirements can optimum efficiency be achieved through design and weight control.

Although the prime purpose of an airplane is to carry the most effective load possible, it is not difficult to overload the airplane, thereby reducing its optimum efficiency. This is especially true of transport types. Therefore it is advisable to consider well the advantages to be gained by making provision in the design for additional passengers, crew, or cargo. Operational simplicity, stability, and safety should be the deciding factors. To apply weight control to the useful load, or to the payload of an airplane, may seem paradoxical. Nevertheless, such weight control must be written into the model specification to insure the best balance and operational characteristics.

Weight Approximations

To stress the total effects of specifying crew, passenger, or cargo requirements, the following weight approximations are presented. These values include provisions, instruments, controls, accommodations, furnishings, etc., as well as those items normally classified as useful load.

Crew Members—300 to 350 lb, average 325 lb each

Passengers—Dayplane—275 to 325 lb, average 300 lb each

Passengers—Sleeper—375 to 425 lb, average 400 lb each

Pounds of Cargo—1.10 to 1.20 lb, average 1.15 lb per lb

Considerations involved in increasing either the number of places or increasing the cargo capacity, should

** The second part of this article which will appear in a future issue features the possibilities for weight control in power plant and equipment, structural weight control, wing and tail surface design, etc.*

always take into account the overall effect on performance and stability.

There are more opportunities for exercising weight control in specifying engines and propellers than are generally realized. Too often the selection is influenced by convention or by previous experiences and contacts. To a certain extent the airplane must be designed around its powerplant, but a wide selection of aircraft engines is available and no design need be compromised by its powerplant installation. Engine selection should allow for comprehensive consideration of the various merits of cooling methods, valve designs, carburetion, etc., for certain features provide substantial weight and performance advantages. Propeller selection should be based on the advantages to be gained from various combinations of blade contours, materials, multiplicity of blades, rotation, etc., and from different methods for control.

Light-Weight Materials

Special consideration should be given to the utilization of light-weight materials and equipment. Where certain materials or equipment are, or can be, definitely established as being superior with respect to weight, strength, and function, extreme care should be exercised to insure that they are individually specified in a definite manner. Such mandatory provisions preclude the possibility of inferior products being specified later on by inexperienced, uninformed, or careless personnel, and will be of appreciable value in insuring an efficient airplane.

As a minor example, nameplates may be cited. Common practice has been to fabricate nameplates from metals. Some weight saving can be achieved, however, by definitely specifying that nameplates be made from plastics in all cases permitted by installation conditions. Even more weight economy can be provided by specifying decalcomania impressions, where practical, instead of nameplates. The weight savings to be gained by substituting lighter weight materials for metal nameplates may seem insignificant but such an attitude is wrong.

Small weight savings are quite important and by writing them into the model specification, an appreciable total of weight economy can be achieved. This attention to small weight savings in the initial directive also produces an advantageous psychological effect that will have additional favorable influence during the projection of the design.

The utilization of standard parts develops appreciable manufacturing and service advantages, especially for accelerated programs, but it cannot be denied that it also imposes weight penalties. Standard parts, and also standard processes, therefore should always be analyzed from an overall airplane efficiency standpoint. Investigations will prove that reworking certain standard parts, or that substituting a special part for the standard, will frequently develop weight economies that appreciably offset any other advantages that may be sacrificed.

A serious lack of weight consciousness exists, according to the author, among designers and engineers responsible for the preparation of model specifications. Possibilities for reducing the overall weight of an airplane are legion. Bold deviation from accepted practice and standard specifications is most effective if intelligently carried out.

Structural design criteria directly influence approximately 1/3 of the weight of an airplane. Load factors are a function of weight, and more study should be given to reducing their values. Some load factors no doubt are unnecessarily high, and current operational practice tends to substantiate this belief. In the author's opinion, load factors for some types of design and construction can be so reduced when writing the model specification that weight economies up to 8% of entire weight of the airplane can be effected.

The case is true with regards to relatively small parts, such as special nuts and bolts, on up to major accessories, some of which, though accepted standards, are notoriously inefficient from a weight standpoint. Since approximately one-fifth of the weight of an airplane is made up of standard parts, particular care should be given to adequate control over their selection when preparing the model specification. Saving equivalent to 1% or more of the plane's weight can thus be achieved.

The quality of workmanship to be performed during the fabrication of the airplane should be definitely stipulated and tied down in the model specification. Examples are: the removal of excess material, the prevention of excess finish coats, the specification of processes, the adherence to design dimensions and tolerances, and the proper selection of raw stock where a material, such as wood, may have a density variation.

Since weight is a function of performance, the design gross weight should be set at the minimum consistent with the performance and all requirements of the model specification. It must be decided, at the conception of the design, what performance characteristics are to be promoted and what ones are to be compromised to obtain the specified performance characteristics. There should be no attempt to straddle. Particular care should be taken to prohibit weight-penalizing compromises and unsatisfactory conditions of stability and balance that otherwise might be developed by alternate loadings and alternate proposals.

The aerodynamic characteristics of the airplane must be those that will be conducive to obtaining the performance desired, conducive to achieving the weight values upon which the performance is based, and conducive to providing the balance characteristics required to develop a practical and efficient airplane. Pet airfoil sections, contours, loadings and other "company traditions" may have to be discarded in favor of more efficient design.

The weight of approximately one-third of an airplane is directly influenced in a conclusive manner by structural design criteria. Load factors are a function of weight and more study should be given to reducing their values. It is believed that some load factors have been unnecessarily high, thus placing needless weight penalties on many airplanes. Current operational practices tend to substantiate this belief. No doubt it will be further proved, as aeronautical science progresses, that load factors, for some types of designs and construction, can be substantially reduced to develop more efficient aircraft. It is possible that weight economies up to 8% of the weight of the airplane can be written into the model specification by means of practical reductions in load factors.

Margins of Safety

Since structural criteria and analyses tend to be conservative, a compensating provision should be written into the model specification. Based on the specified load factors and normal rated power of the engine(s), negative margins of safety of .05 should be allowed by specification. By the same token, positive margins of greater than .05 should be prohibited by specification. It may require additional effort to design structures to within marginal limits of plus or minus 5%, but that is weight control. Future designs that do not adequately provide rigid structural weight control by means of the model specification or the design directive will contribute little toward aviation and its progress.

MARTIN USA

REG. U. S. PAT. OFF.

"Another Martin First!"

AMERICA'S FIRST *power-operated aerial gun turrets were built in 1937 by Martin for its PBM-1 Navy patrol bomber (shown at left). Martin pioneering paid big dividends to America's war effort.*

U. S. Planes Pack a Potent Punch thanks to MARTIN-MADE GUN TURRETS

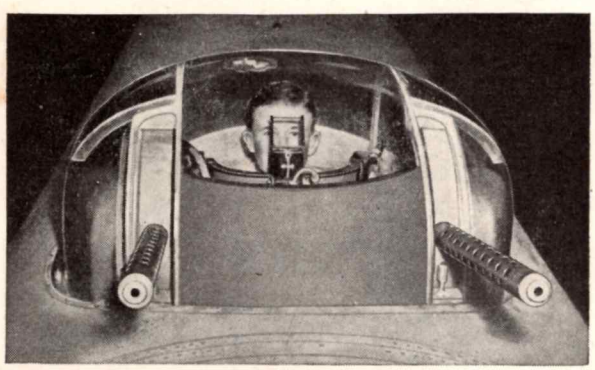
HOW does it happen that Martin, long famed for its fighting planes, is now also one of the world's largest manufacturers of power-operated aerial gun turrets? As far back as 1937 Martin engineers had foreseen the need for powered gun turrets and built America's first for their PBM-1 patrol bomber. When, in 1940, General Arnold proclaimed power gun turrets a "must," Martin was ready with actual experience and production know-how. Results: Martin is now mass-producing turrets not only for Martin aircraft, but for many other U. S. types as well. When you see pictures of high-speed bombers, the chances are 9 out of 10 that they are defended with Martin turrets.

Mass-Producing Gun Turrets

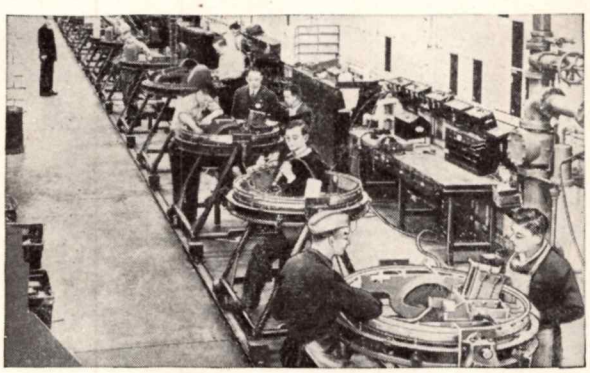
To give U. S. bombers a pulverizing punch and to lessen the need for fighter escort, Martin has turned its entire Sinclair division over to the manufacture of turrets. Martin engineers, seeking ways to turn out turrets faster, achieved these results. The inner ring was cast as a single unit . . . moving assembly lines were perfected . . . and the "chassis" of the turret was cast in one piece, a feat which many experts had deemed impossible. Today, turrets . . . both electrically and hydraulically powered . . . are rolling from Martin assembly lines to make U. S. bombers feared by enemy airmen.

New Improvements

Hardly a week passes without changes or improvements being made in Martin turrets, to keep well ahead of the enemy. Plastics are being utilized to save metal . . . added comfort and protection are provided for gunners . . . and in numerous other ways Martin gun turrets are being improved to give U. S. planes a punch that spells "k.o." for the Axis—and Victory for US.



WICKED WALLOP is packed by these twin 50's in the Martin turret of a Martin B-26 Marauder. At high altitudes, where the slightest exertion is an effort, power turrets, easily operated by a twist of the wrist, are vital to Victory.



TORRENT OF TURRETS pours from Martin factories, via moving assembly lines like this. Simplified design and advanced tooling boost Martin output. At end of line, guns are installed and turrets are ready to do business with Hitler.

THE GLENN L. MARTIN CO., BALTIMORE — THE GLENN L. MARTIN-NEBRASKA COMPANY—OMAHA

Martin AIRCRAFT

Builders of Dependable Aircraft Since 1909

Maintenance and Repair of Metal Aircraft

JOSEPH LUX

● The ever increasing demand for all types of technicians and skilled mechanics for the maintenance and repair of our military aircraft has made maintenance training an important part of the programs of all leading aircraft manufacturers.

Repair of aircraft requires extensive training of personnel in the various phases of structures, mechanics, mathematics, shop practice, field equipment and materials. The trainee must be qualified before entering field work and must be thoroughly acquainted with all phases of the aircraft in order to insure safety of the pilot and the airplanes. The achievements of field representatives in safeguarding our pilots and our airplanes has been a strenuous task and the results have been most gratifying.

But the maintenance and repair of modern aircraft, to be efficient, must be conceived by the designer and every effort must be focused in this direction during the early engineering stages. How often a moving part should be serviced, and the accessibility to vital parts for servicing and maintenance depends entirely upon the thought and effort put behind each individual problem at the time the layouts are made.

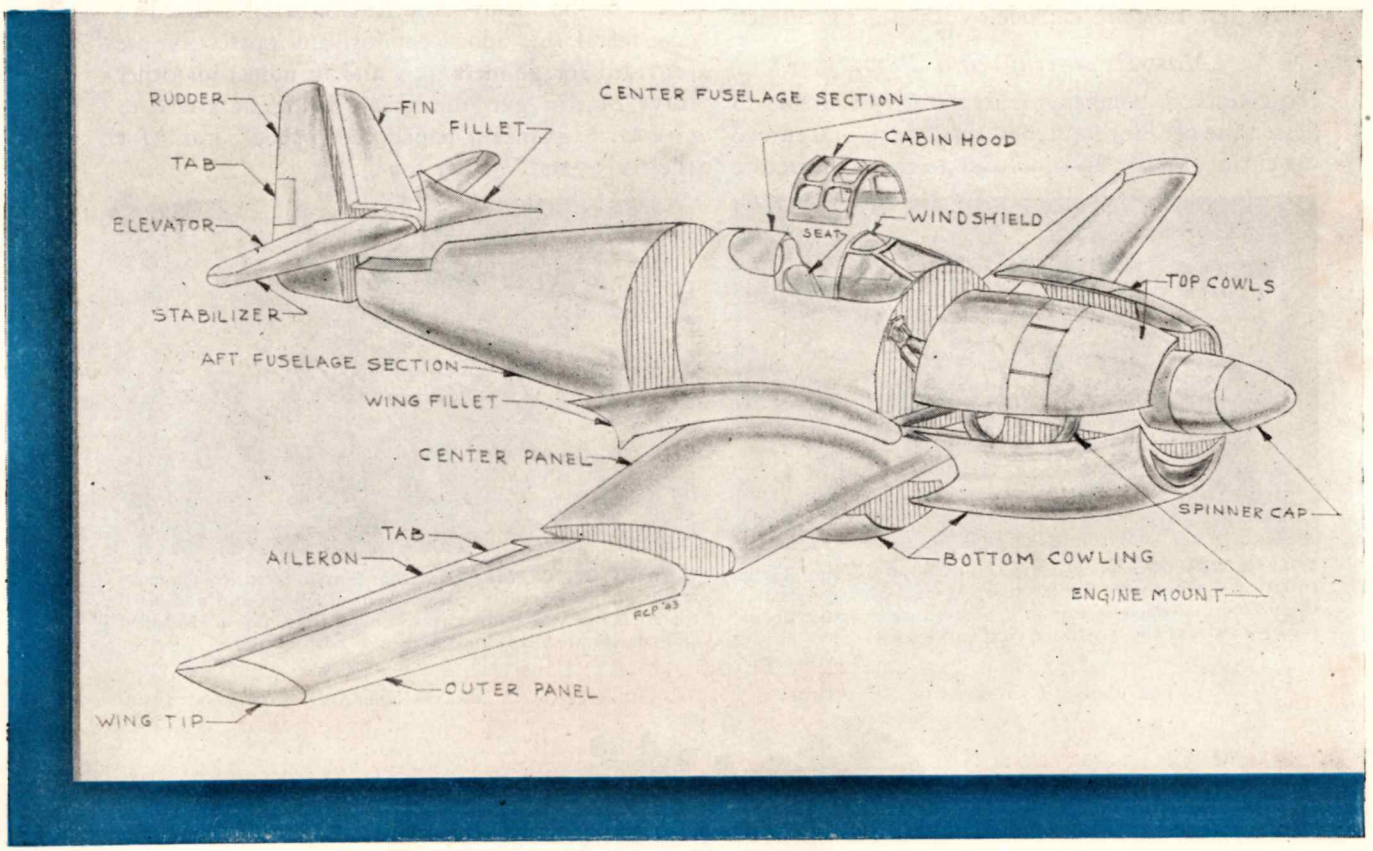
Draftsmen Should Strive for Simplicity

The draftsmen should employ the fundamentals of physics and engineering and should strive for simplicity and originality in order that the service representative can get the job done faster and better in the field.

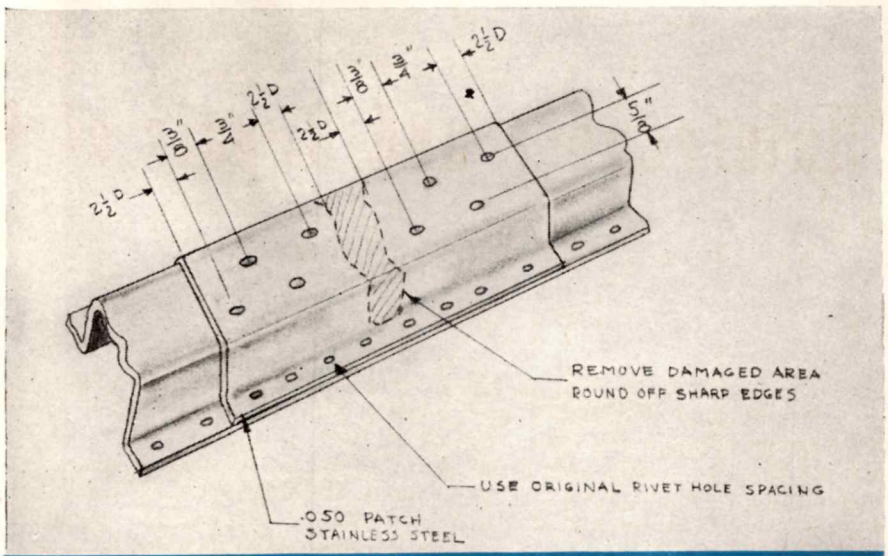
The repair of metal aircraft is an important specialized phase of design —one in which a great deal of thought must be given toward the end of conserving metal and of facilitating salvage work on damaged planes. The complexity of the structural repairs points the need for simpler designs of component parts without sacrifices of the stress values required. Arrangement of the bulkheads, longerons and so forth must be carefully thought out and laid out in accordance with the purpose for which the airplane is going to be used. It is readily seen why the design in its basic conception has a very important bearing on the repair problem.

Because of the structural nature of metal aircraft, it becomes quite difficult to repair them when the structure and skin are damaged whether by shell fire or forced landings. The structural network of the airplane entails an ex-

An exploded view of a typical all-metal fighter aircraft, showing major structural elements



tensive inspection of the area, and salvage methods must be devised before attempting the repair. The structure about the area must be analyzed as to the type, gage, and rivet pattern of the damaged material. Fine hair-like cracks should be encircled or marked for further inspection. Brackets, clips, fittings and rivets should be removed, if damaged in any way, and distorted members should also be noted for removal. Upon the completion of a satisfactory inspection, the airplane should be correctly supported and aligned for removal of the damaged area, which should then be cleaned thoroughly and further analyzed as to the type of the repairs needed. Finally, the necessary materials are obtained.



Patching hat-shaped channels by nesting an overlap channel of like gage and material. Damaged area is thoroughly cleaned and edges smoothed. Next size channel is placed over existing channel picking up existing rivets of channel flanges and employing four rivets as spaced on each side of damage. If damage is great, like material of next heavier gage should be used

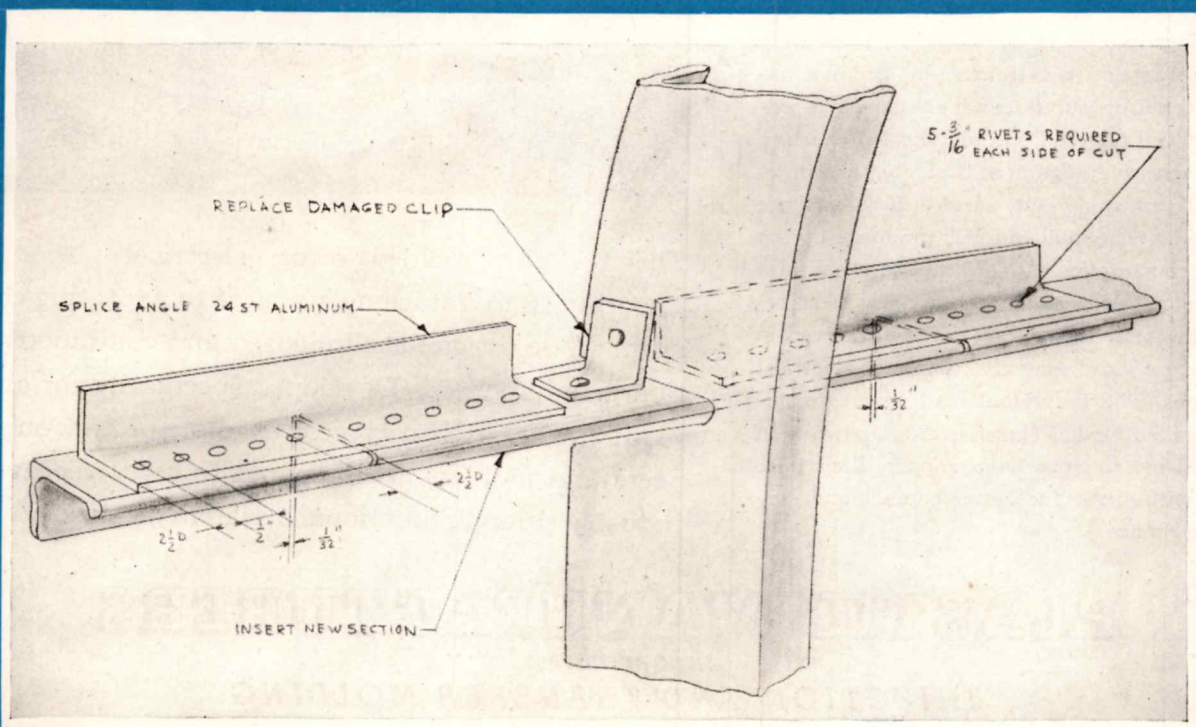
Procedure for Cleaning Damaged Areas

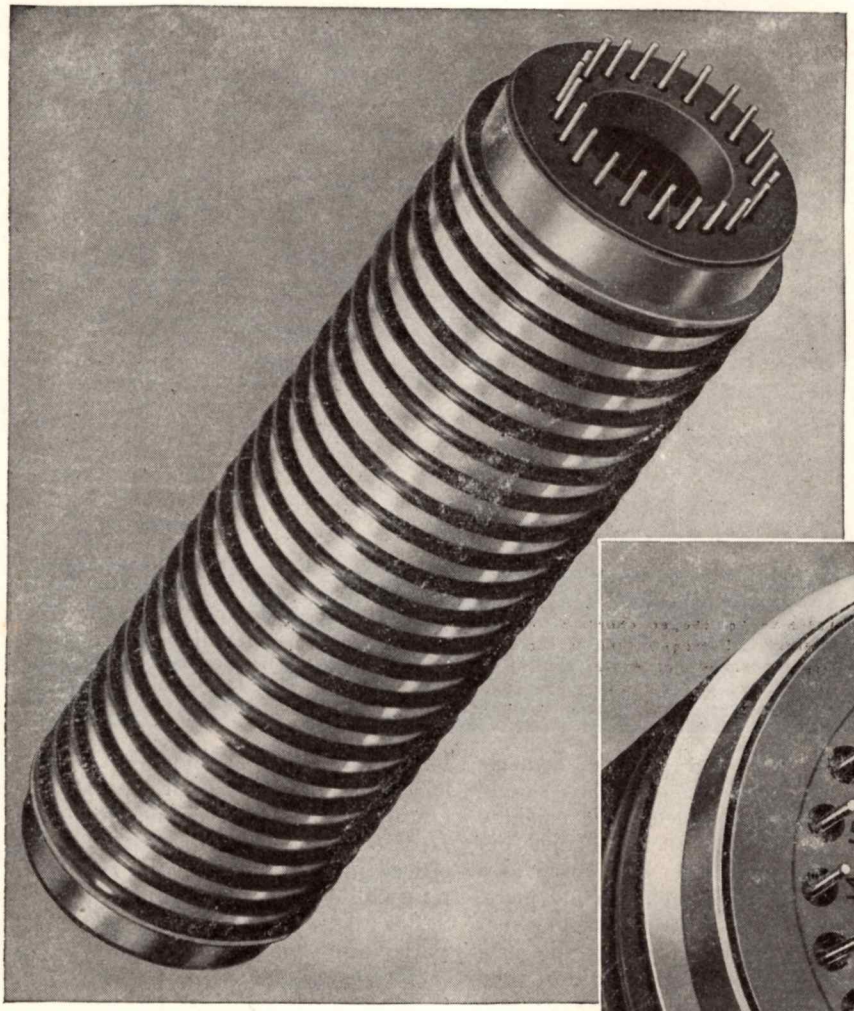
The usual procedure in cleaning an injured area is as follows. Tiny cracks should have small holes drilled at their extremities in order to prevent them from spreading as a result of vibration. Cracks, holes and deep scratches, which might impair the original structural design of the area affected, require reinforcement sheets fully overlapping the damaged area. Damage which cannot be remedied merely by patching should be cut away and a piece of material like in form, gage and quality inserted and spliced at the ends, by means of patches. Damage involving over 75% of a part should be handled by complete replacement—existing rivets just being drilled out and the original rivet holes used as a pattern for the replacement piece. Damage in the highly stressed areas should be entirely replaced or the next heavier gage material used for reinforcement. Rivets should be of proper length and type for each separate operation. The skin section should be repaired last, using flush type rivets spaced in accordance to the rivet pattern within the damaged area.

For determining the strength of parts, and the number and type of

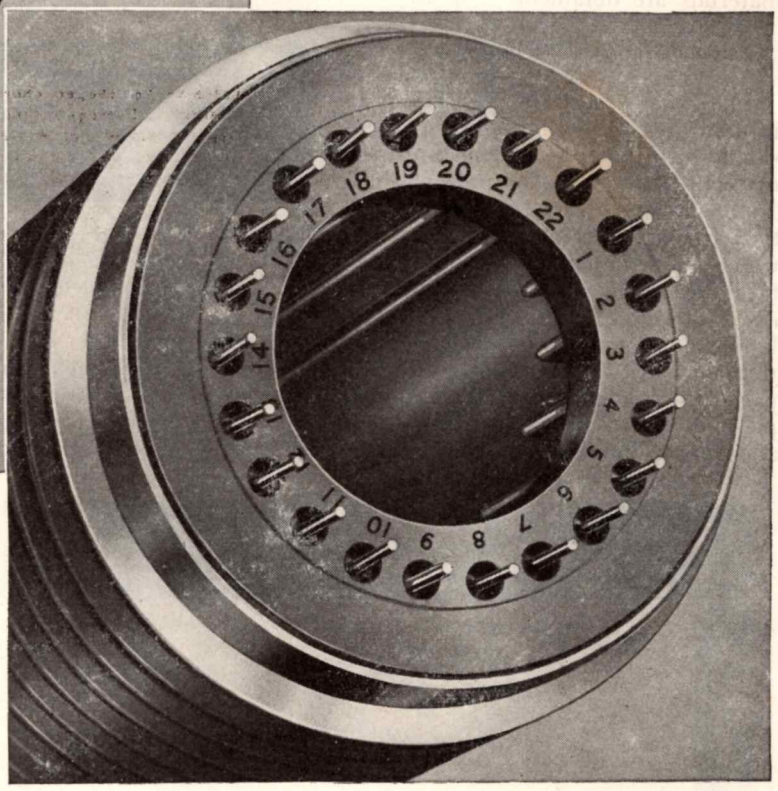
(*Continued on page* 257)

Splice angles for new stringer insert—fuselage. New insert is attached by means of splice angles with definite number of rivets on each side of splice





An EXAMPLE of FUNCTIONAL DESIGN in PLASTICS



HOW PLASTICS ENGINEERING DID THE JOB BETTER

The 22 rings in this one-piece slip ring assembly are precisely spaced and transfer-molded in a material selected by our research engineers to provide balanced physical and electrical properties. ▪ Permanent ring alignment is insured and practically all assembly and service problems are eliminated. ▪ The molded finish produced by our one-unit construction is more moisture resistant than a machined surface, with a consequent reduction in power loss. ▪ Projection of molded-in lead wires provides easy attachment of electrical connections. The individual lead wires are numerically identified as shown in enlarged view on right. ▪ Bi-metal rings have copper alloy base finished with silver for better contact and corrosion resistance.

Through this molded rotor, electrical power flows smoothly from a stationary source to a rotating control unit. Wire fatigue is eliminated and continuous rotation is unimpeded. Developed specifically for aircraft requirements, it is a typical example of how our engineers and molders are prepared to serve the aviation industry through functional design in plastics.

PLASTIC MANUFACTURERS

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INJECTION AND TRANSFER MOLDING

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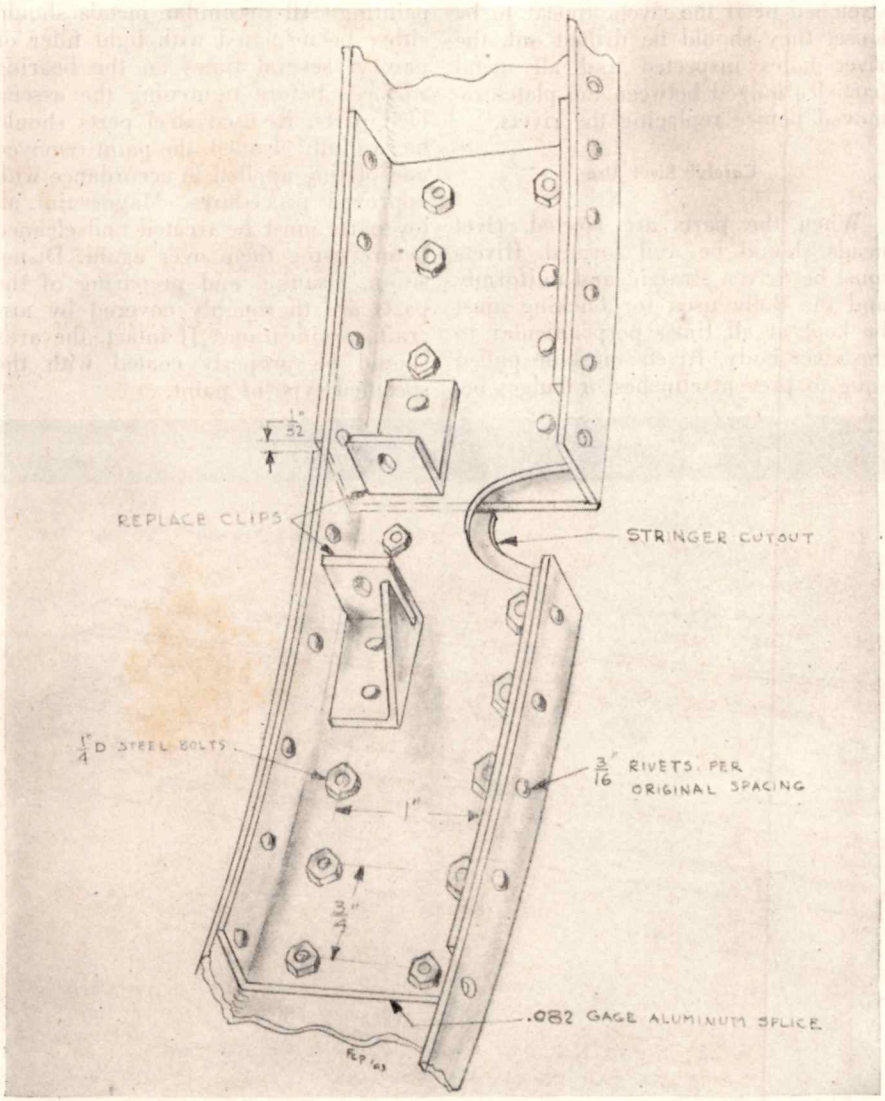


Reinforcement of a damaged bulkhead at stringer cutout—fuselage. Channel of like material and gage is nested upon cleaned damaged bulkhead and bolted by definite number of 1/4-in steel bolts so that original design load may be maintained

swer is then divided by the allowable unit bearing strength of the metal. This figure is divided again by the thickness of the sheet and the diameter of the rivet selected. The rivet bearing strength is not considered because the rivet does not fail in bearing. The final answer denotes the number of rivets to be used.*

As an example of the use of the above calculations, let us assume the cross-sectional area of the material selected as .072 in. The material being aluminum,** its ultimate strength is 65,000 psi, thus:

$$.072 \text{ in} \times 65{,}000 = 4680.0$$
$$4680.0 \text{ in} \times (1 + .15) = 5382.0$$

The ultimate stress of the rivet in shear is 25,000 psi, hence:

$$\frac{5382.0}{25{,}000} = .2153 \text{ sq in}$$

The area of a 3/16-in diameter rivet is .0276 sq in, so that

$$\frac{.2153}{.0276} = 8 \text{ rivets (required)}$$

Calculation for bearing:

$$4680.0 \times (1 + .28) = 5990.4$$

The allowable bearing strength of the material being 90,000 lb/sq in:

$$\frac{5990.4}{90{,}000} = .067 \text{ sq in}$$

As the metal is .072 in thick, and a 3/16 in rivet has been selected:

$$\frac{.067}{.072 \times 3/16} = 5 \text{ rivets (required)}$$

Therefore, calculations show that eight rivets are required for this par-

*The greater number arrived at in either set of calculations must be used.

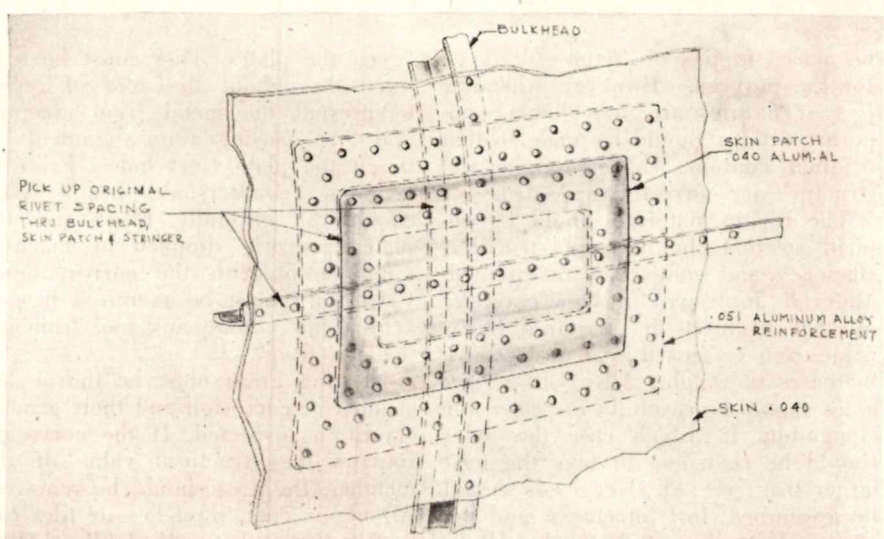
**Aluminum rivet margins of safety are as noted: for flush type rivet .15 in shear and .28 for bearing; flat head type of rivet is .35 in shear and approximately .80 for bearing.

(*Continued from page* 255)

rivets to use when effecting repair work, the following procedure is suggested. To obtain the ultimate strength of the material required, the cross-sectional area of the material is multiplied by the ultimate tensile strength of the material. The product is then multiplied by the sum of unity plus the required margin of safety—which will give the minimum rivet strength needed for the repair. This value or number, divided by the allowable unit shearing stress of the rivet material, will give the total rivet cross section required. This last value, divided by the area of the rivet required, will give the number of rivets needed for shear strength.

To find the bearing value of a rivet in respect to the material, the ultimate strength is obtained as above and is multiplied by the sum of unity plus the required bearing margin. The an-

Flush type skin patch at bulkhead and stringer area—fuselage. Patch frame is riveted between bulkhead flange and stringer leg with flush type rivets. Patch is then riveted to frame, picking up existing bulkhead and stringer rivet spacing



ticular repair. If the repair is an insertion, the eight rivets are to be correctly spaced on each side of the patch allowing a two-and-one-half rivet diameter edge distance and using a total of 16 rivets at the extremities of the insertion.

The airplane structure must be supported wherever the damage is excessive, so that proper alignment can be maintained during the repair operations. Fixtures should be made for this purpose and all contact points should be padded. Sectional repairs, if removed from the airplane, should be placed in jigs or fixtures designed for the purpose. However, whenever jigs or fixtures are unavailable, temporary set-ups should be made so that original contour, shape, weight and structure are correctly supported.

The repair material should be applied so that the original structural efficiency and contour is maintained. Materials for repair must be carefully selected to meet the required stress values and yet guard against excessive increases in weight. All existing rivet holes should be carefully inspected for elongation, in which case the holes should be re-drilled to take the next larger size rivet. All rivet heads should be examined for intactness and security of attachment. If the heads are stretched or if the rivets appear to be loose, they should be drilled out, the rivet holes inspected and all metal particles lodged between the plates removed before replacing the rivets.

Careful Rivet Use

When the parts are riveted, rivet heads should be well formed. Rivets must be driven straight and uniformly and the dolly used for bucking must be kept at all times perpendicular to the rivet body. Rivets must be pulled snug to prevent clinches or bulges between the plates. They must be scattered throughout the area of repair to prevent the metal from creeping and thus causing a misalignment between the plate rivet holes. Prior to riveting, countersunk head rivets should be carefully fitted and the plates properly dimpled or machine countersunk with the correct tools. Great care must be exercised in preventing the countersink tool from going too deep.

Existing areas must be thoroughly cleaned of corrosion and their general condition inspected. If the corrosion impairs the structural value of the member, the area should be removed. All minor cuts, scratches or files can be filled in with specified filler before painting. All dissimilar metals should either be insulated with light filler or painted several times on the bearing surfaces before tightening the assembled parts. Re-used steel parts should be carefully cleaned, the paint removed and plating applied in accordance with approved procedures. Magnesuim alloy parts must be treated and cleaned before using them over again. Disposition, cleaning and preparing of the parts are thoroughly covered by aircraft specifications. If intact, the area should be properly coated with the specified type of paint.

As various types of dollies or bucking tools are available, the proper tool should be selected in each case, when effecting repairs. Internal structural repairs may call for flat head, brazier head or round head rivets, and these can be squeezed with the use of special tools. However, repair areas on ailerons, wing tips, stabilizers, rudder or elevators—where the bucking of rivets becomes extremely difficult —require special rivets. Blind riveting is customarily done with rivnuts, cherry rivets or explosive rivets. Because of the stress value of blind rivets, two rivets are usually used in place of one standard rivet. Due to the skin metal thickness of these areas, "oil

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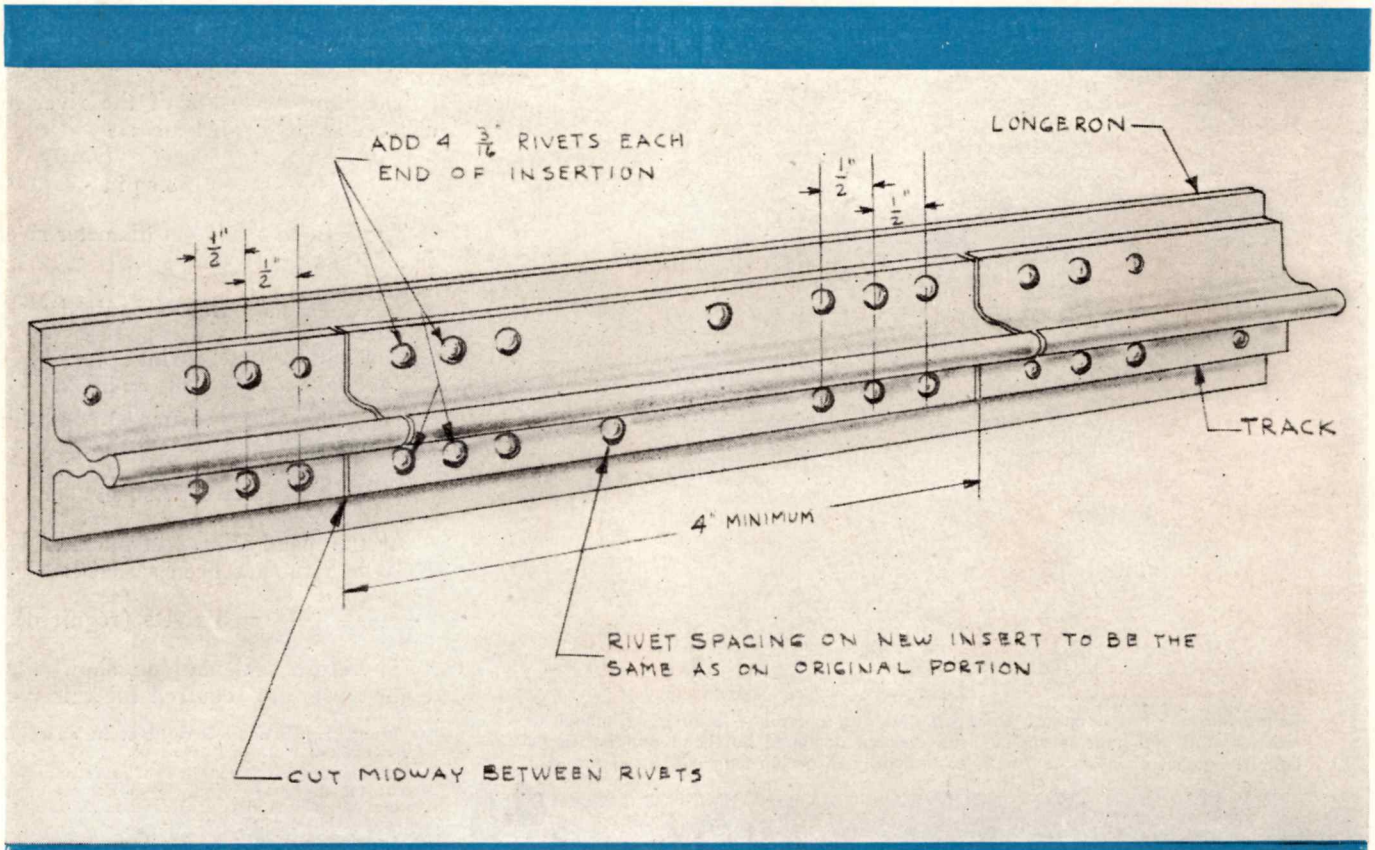
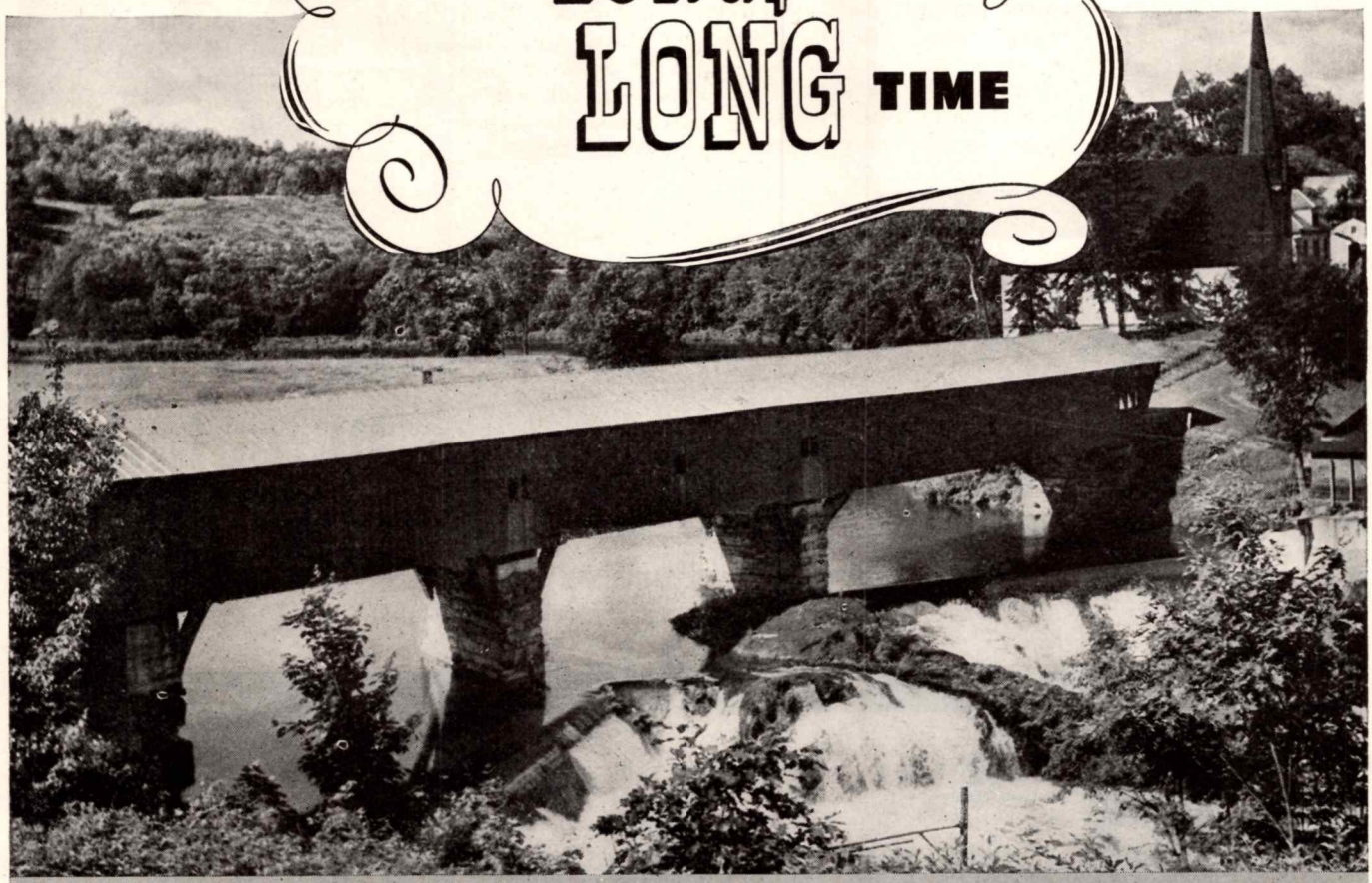


Repair of canopy track which is riveted to upper longerons of fuselage structure. This type of repair may necessitate repair of longeron. In this case, track splice should be staggered so that track contour is maintained. Rivets to be added and spaced according to design load of damaged area

FOR A LONG, LONG TIME

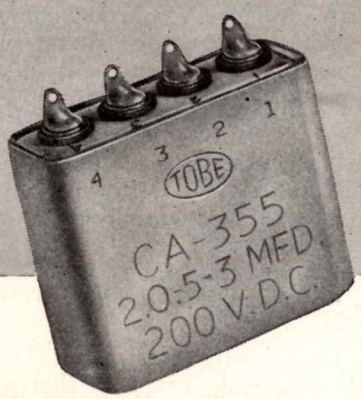


One reason why Tobe Capacitors have forged to the front is their consistently long life. But there's another reason — the successful pioneering work of Tobe engineers.

Take as an example the CA—355, shown below in streamlined, hermetically sealed drawn container. It is being used in large quantities by the U. S. Army Signal Corps in front line telephones.

Tobe is the only manufacturer furnishing this capacitor in a drawn container.

The CA—355 is just one instance of Tobe engineering ingenuity in developing and perfecting new devices. However tough your own condenser problems we invite the opportunity for our engineers to help you solve them. Please get in touch with us.



LONG-LIFE ASSURED

For This Unique Capacitor

SPECIFICATIONS—CA—355

Wax impregnated, wax filled capacitor

Capacity Rating:.....2.0—0.5—0.3 mfd.
Voltage Rating:.....200 D C
Power Factor:..@ 1000 cycles .01 maximum
Resistance:....2000 megohms per microfarad
Dimension: 1″ depth—2½″ length—2⅛″ height

Meets requirements of U. S. Army Signal Corps

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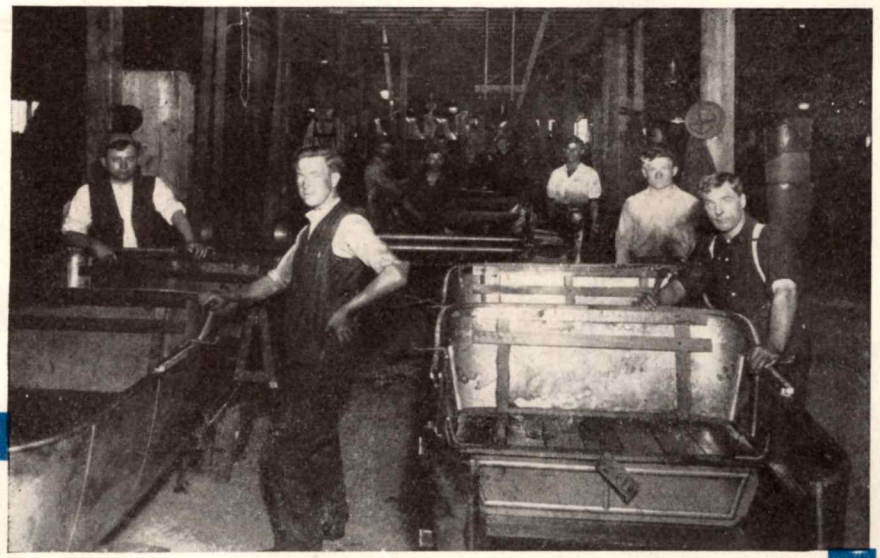
***A small part in victory today*—A BIG PART IN INDUSTRY TOMORROW**



Assembly line of Ford automobile bodies back in 1912, showing the first contoured drawn sheet steel panels ever produced

Models Help in Production Planning

HARVEY G. GROEHN
President, Castaloy Corp. of California

● A basic key to low-cost, continuous production of aircraft lies in the creation of preliminary mock-ups, then production master models and checking fixtures—so that all development work flows in a harmonius, steady stream, from the earliest design stage to the completion of the final assembly work on the first unit. Coincident with the establishment of reference points on the first mock-up and the translation of such layout data by means of templates into engineering information, there are two planning functions which must be performed.

The first of these planning functions consists in the making of a small-scale model, embodying desirable production breakdowns of assemblies and sub-assemblies so that each section of the miniature can be placed into a jig or fixture of the same scale, making possible a determination of the amount of space available for equipment and other purposes, the most efficient handling and assembly procedures to be adopted, and so forth—to the end that full value and use may be made of the factory space.

By the use of three-dimensional miniature scale models of the assembly and of the corresponding machinery and fixtures, many errors in production may be eliminated before thousands of hours and dollars are wasted. Planners, designers, supervisors and those responsible for the tooling and preparation of equipment for production, always welcome a scale model.

Scale Model Gives "Feel" of Job

It gives them an actual "feel" of their job months in advance, plus dependable if fractional specifications for guidance throughout all tooling phases, and the maneuvering of assemblies before the full-size production unit is built.

The miniature models are constructed from scale templates that are reduced from the full-size templates, produced from engineering data obtained from the first clay or plaster mock-up of the complete assembly. It

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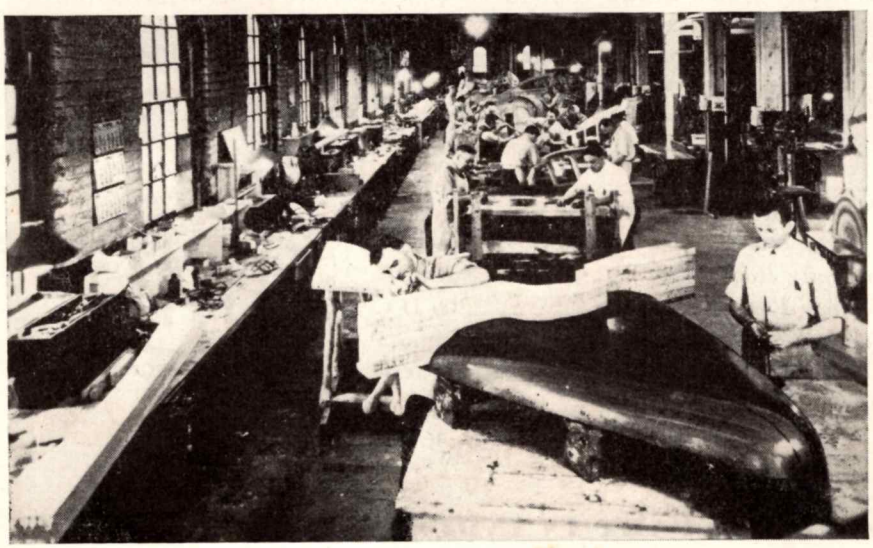

Some of the master mahogany models and checking fixtures used for tooling of the 1942 model Hudson

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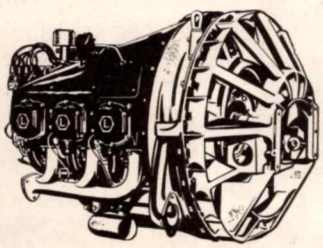
THE DAY YOU PUT THE FIRST SOLO FLIGHT BEHIND YOU!

No. 5 of a series sketched from life by Clayton Knight



Lycoming Model O-435-T six cylinder opposed 162 net horsepower engine complete with cooling fan and cowling for submerged installations.

MAKERS OF AVCO PRODUCTS

In spite of the Axis' head-start to war, America's airmen are going into action the best-trained flyers on earth. There is pride in that for every American. There is especial pride for the people of Lycoming, where thousands upon thousands of engines for training planes are made. Dependability is a Lycoming watchword. Today it is one we guard more jealously, if possible, than ever before!

LYCOMING

AIRCRAFT ENGINES

LYCOMING DIVISION — THE AVIATION CORPORATION, WILLIAMSPORT, PA.

(*Continued from page* 260)

has been contended that these miniature models and fixtures are expensive or superfluous. The truth is that when from $3000 to $10,000 are spent on scale models and fixtures for an airplane, savings in cost and delivery due to the elimination of so-called "engineering changes" on only *one* of the thousands of required tools will cover the original outlay for the miniature.

The second major engineering function closely follows and is coordinated with the creation of the miniature breakdown scale model and fixtures. This consists of building full-scale master mahogany models of each section of the miniature breakdown. These models are built of seasoned, kiln-dried Honduras mahogany from full size steel templates which have been developed from the original mock-up, and have been laid out in detail on master sheet-metal drafts or lofts.

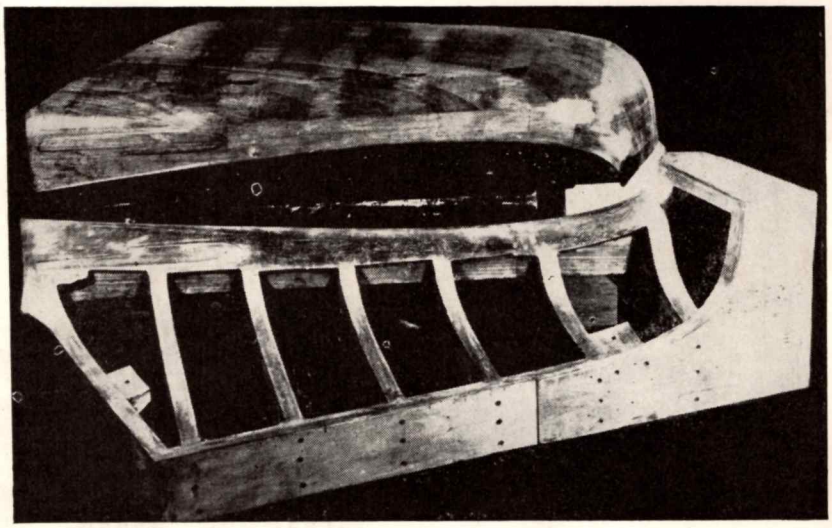
Purposes of Master Models

The manufacture of these master models is done for three major purposes: (a) to check the original master engineering layout and templates; (b) to provide three-dimensional detailed information needed to plan operations on individual parts, and to determine set-ups and assembly sequences; (c) to furnish a means of transferring the correct detailed shapes, contours, trim and flange lines, holes, offsets, embossings, and so on, to every tool involved in the fabrication of each individual part in the assembly.

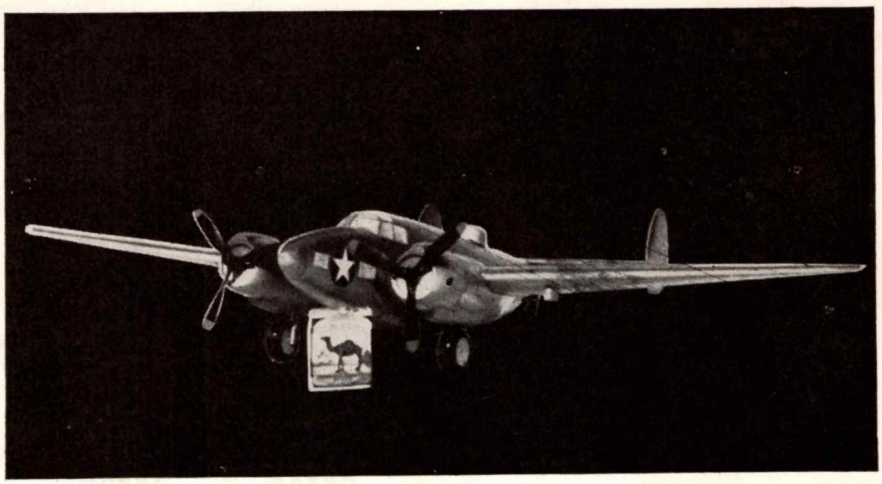
To expound the first purpose, any errors in engineering layout or templates which have accumulated at this stage, are immediately picked up and checked by the making of the first precision unit in mahogany. Any errors can be immediately called to the attention of the engineering department so that corrections can be made prior to release of tooling information to individuals, divisions or sub-contractors engaged in the detailed production tooling and assembly work. This further insures coordination and the orientation of all effort toward the original frame of information, since all full-size master model work is done with standard precision equipment, such as surface plates, angle plates and height gages.

The second purpose of the full-scale master model is to provide an accurate means whereby all tooling supervisors, planners and designers can readily visualize all the detailed information they

(*Continued on page* 264)

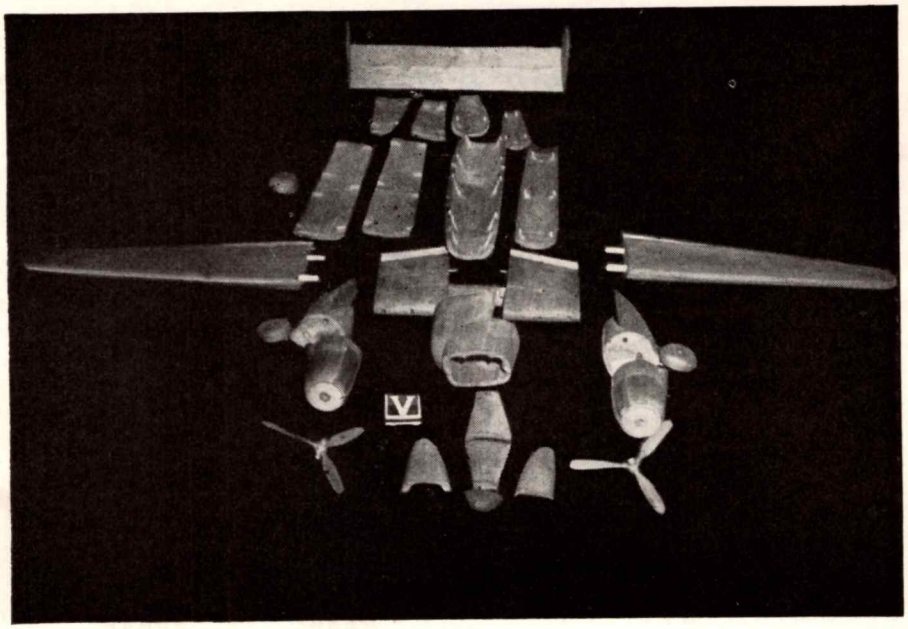


Foreshadowing technique now adapted to aircraft—master mahogany model and female checking fixture for automobile hood panel



Fully assembled miniature model of twin-engined aircraft. Cigarette package indicates the comparative scale

A completely "broken-down" miniature scale model of an airplane



Danly Die Sets are not products that get to the front. Their job is in a thousand factories in the presses that stamp out and form parts for all branches of the service.

They are products for a thousand end uses. They are aiding American Industry to produce ordnance and equipment enabling American Fighting Men to win the war.

If your production calls for die sets, call for Danly. Danly service to customers is still increasing despite the strain of war schedules.

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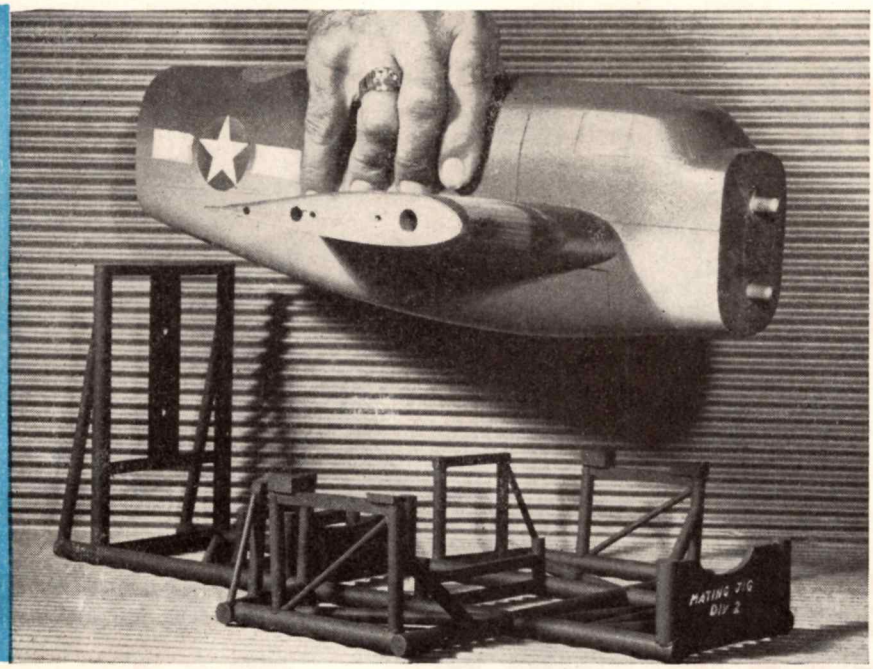
DANLY DIE SETS

Welded Steel Fabrication



Section of miniature scale model being set in model of production jig to plan and check operations

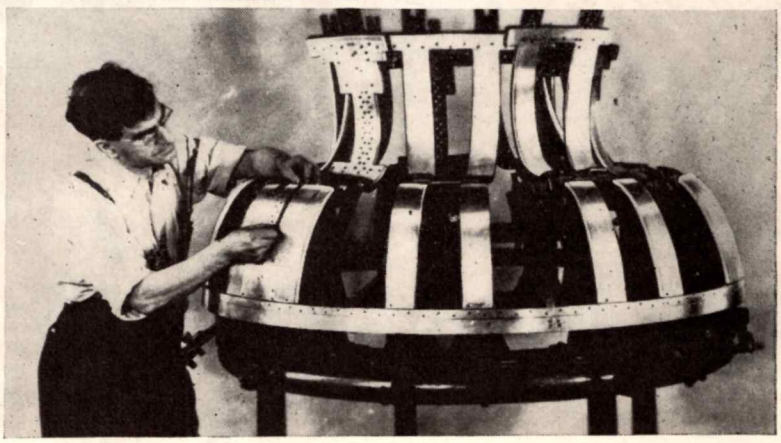
(*Continued from page* 262)

require for the planning of individual tools, dies, jigs and fixtures. Problems that are impossible to solve accurately by means of flat templates or drawings, are easily resolved, and workable answers are readily found through reference to three-dimensional information that is known to check back to engineering and to be coordinate with the overall production of the finished assembly.

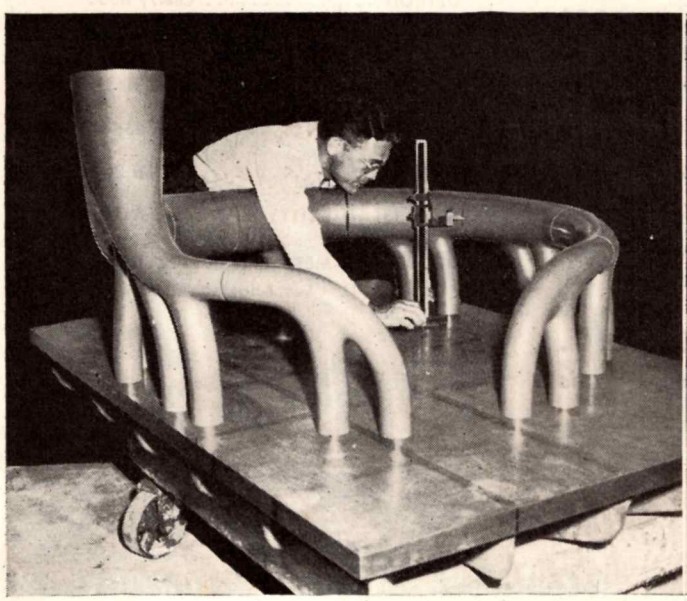
Many problems, such as that of consolidating operations so as to reduce the number of separate steps; that of deciding on exactly what type of tools will be required, and how large they should be; that of settling on the type of construction and materials to be used in the tools, and their cost; that of determining what equipment is necessary to operate them, and the production cycle indicated to produce a finished operation on each tool—all such posers can be more readily and accurately solved when full-scale models are available for reference.

The third purpose, provision of the means for transferring the correct detailed information to all individual tools, dies, jigs, and fixtures, is fulfilled as follows. All parts that are produced on individual dies, jigs and fixtures must have their contours, holes, trim and flange lines, offsets and so forth, in the same relative positions as on the master mahogany model. For if they differ, the accumulation of differences will cause tremendous labor costs and also de-

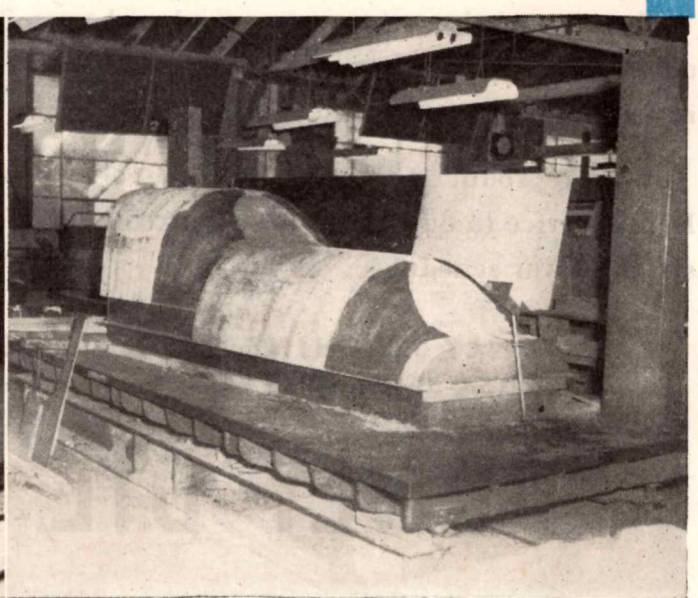
(*Continued on page* 286)



Engine cowling assembly tool produced from mahogany models by casting low-melting-alloy surfaced fixtures



Checking full size master model with height gage on surface plate



Master model for coordinating all tooling for sheet plastic assembly

BLUEPRINTS OF SAFETY

ARMY E NAVY

WEATHER OR NO...

It's a tough job at best...this business of bombing, but around-the-clock it must continue...if we'd shorten the path to victory ...and it's during the jittery hours of darkness...or when fog shuts down, that getting home in safety depends on accurate radio transmissions. "Blueprints of Safety" assure that A. A. C. whip-antenna is reliable at all times, and under the most exacting conditions. Its automatic direction finder allocates the course and an additional safety factor is the retractable feature, which facilitates easy replacement from within the ship.

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STANDARD COPPERS CHART

● The accompanying chart lists the principal standard commercial wrought coppers and copper-base alloys, and gives their analyses as well as the forms in which they are most generally available. It was prepared by the Copper & Brass Research Assn. and is designed to set forth only those alloys which, over a period of years, have been most commonly ordered in large quantities. While there are hundreds of copper-base alloys, this list of 38 will ordinarily serve most of the requirements for both war and peacetime products.

Special Alloys Still Available

Special alloys will, of course, continue to be available for the particular uses for which they are specifically required. In addition to these listed, there are many special and proprietary alloys which can be and are produced by the mills for various uses, including such types of alloys as aluminum bronzes, cadmium bronzes, beryllium coppers, aluminum-tin bronzes, aluminum-silicon bronzes, silicon bronzes, copper-chromium alloys, etc. However, it is believed the listing of the standard alloys as shown, will materially simplify the preparation of engineering specifications. It is planned by the Copper & Brass Research Assn. later on to supplement this list of alloys by data sheets covering physical and chemical characteristics applicable to each of these alloys.

NAME	COMPOSITION Per Cent	FORMS GENERALLY AVAILABLE *Indicated by (√) or by reference to nearest applicable A. S. T. M. Specifications*					
	Commercial Limits	Flat Rolled Products	Rod and Drawn Bar	Shapes	Wire	Tube	Refer to Alloy Data Sheet
COPPERS							
Electrolytic tough pitch Copper	Cu 99.90 min.	B152 Type A	B124 #12 B133	B124 #12 B133	B1 B2 B3		
Phosphorized Copper	Cu 99.90 min.					B42, B68 B75, B88 B111	
PLAIN BRASSES — NON-LEADED							
Gilding Metal	Cu 93.5 –96.5* Zn Remainder	B36 #1					
Commercial Bronze	Cu 89.0 –92.0 Zn Remainder	B36 #2 B130			B134 #2	√	
Red Brass	Cu 83.0 –86.0 Zn Remainder	B36 #3			B134 #3	B43 B111 B135 #1	
Low Brass	Cu 78.5 –81.5 Zn Remainder	B36 #4			B134 #4		
70/30 Brass	Cu 68.5 –71.5 Zn Remainder	B36 #6 B19			B134 #6	B14 B135 #2	
High Brass	Cu 63.0 –67.5 Zn Remainder	B36 #8			B134 #7		
Muntz Metal	Cu 59.0 –63.0 Zn Remainder	√	B124 #1			B111 B135 #5	
LEADED BRASSES							
Leaded Commercial Bronze	Cu 87.5 –90.5 Pb 1.25– 2.25 Zn Remainder		B140 Type B				
Low-Leaded Tube Brass	Cu 65.0 –69.0 Pb 0.30– 0.80 Zn Remainder					B135 #3	
High-Leaded Tube Brass	Cu 65.0 –69.0 Pb 1.25– 2.00 Zn Remainder					B135 #4	
Light-Leaded Brass	Cu 63.5 –67.5 Pb 0.15– 0.35 Zn Remainder	√					
Low-Leaded Brass	Cu 62.5 –66.5 Pb 0.30– 0.70 Zn Remainder	√					
Medium-Leaded Brass	Cu 62.5 –66.5 Pb 0.75– 1.25 Zn Remainder	√					
High-Leaded Brass	Cu 60.5 –64.5 Pb 1.25– 2.25 Zn Remainder	B121 #4					
Extra-High-Leaded Brass	Cu 60.0 –64.0 Pb 2.00– 3.00 Zn Remainder	√					
Free-Cutting Brass	Cu 60.0 –63.0 Pb 2.50– 3.75 Zn Remainder		B16	√			
Leaded Muntz Metal	Cu 58.0 –62.0 Pb 0.35– 0.90 Zn Remainder	B171					
Free Cutting Muntz Metal	Cu 59.0 –62.0 Pb 0.90– 1.40 Zn Remainder					√	
Forging Brass	Cu 58.5 –62.0 Pb 1.50– 2.50 Zn Remainder		B124 #2				
Architectural Bronze	Cu 55.0 –60.0 Pb 2.00– 3.75 Zn Remainder			√			
TIN AND ALUMINUM BRASSES							
Admiralty	Cu 70.0 –73.0 Sn 0.90– 1.20 Zn Remainder					B111 Types A, B, C & D	
Naval Brass	Cu 59.0 –62.0 Sn 0.50– 1.00 Zn Remainder	B171	B21 Grade A B124 #3				
Leaded Naval Brass	Cu 59.0 –62.0 Sn 0.50– 1.00 Pb 1.25– 2.25 Zn Remainder		B21 Grade C				
Manganese Bronze	Cu 57.0 –60.0 Sn 0.50– 1.50 Fe 0.80– 2.00 Mn 0.50 max. Zn Remainder		B124 #4 B138 Type A				
Aluminum Brass	Cu 76.0 –79.0 Al 1.75– 2.50 Zn Remainder					B111 Types A, B, C & D	
PHOSPHOR BRONZES							
Phosphor Bronze — Grade A	Cu Remainder Sn 3.50– 5.80 P 0.03– 0.35	B103 Grade A	B139 Grade A		B159 Grade A	√	
Phosphor Bronze — Grade C	Cu Remainder Sn 7.00– 9.00 P 0.03– 0.35	B103 Grade C	B139 Grade C		B159 Grade C		
Phosphor Bronze — Grade D	Cu Remainder Sn 9.00–11.0 P 0.03– 0.25	B103 Grade D			B159 Grade D		
Phosphor Bronze — Grade E-1	Cu Remainder Sn 1.50– 2.00 P Trace				√		
Phosphor Bronze — Grade E-2	Cu Remainder Sn 1.00– 1.50 P Trace	√			√		
CUPRO-NICKEL and NICKEL SILVERS							
Cupro-Nickel	Cu Remainder Ni 29.0 –33.0	B122 #5 B171				B111 (70-30)	
Nickel Silver Alloy A	Cu 63.0 –66.5 Ni 17.0 –19.5 Zn Remainder	B122 #2	B151 Alloy A		B151 Alloy A		
Nickel Silver Alloy B	Cu 53.5 –56.5 Ni 17.0 –19.5 Zn Remainder	B122 #4	B151 Alloy B		B151 Alloy B		
SILICON BRONZES (Copper-Silicon Alloys)							
Silicon Bronze — Type A	Cu 94.8 min. Si 2.75– 3.50	B96 Type A B97 Type A	B98 Type A		B99 Type A	√	
Silicon Bronze — Type B	Cu 96.0 min. Si 0.75– 2.00	B97 Type B	B98 Type B		B99 Type B	√	
Silicon Bronze — Type D	Cu 94.0 min. Si 2.75– 3.50 Pb 0.20– 0.80		B98 Type D				

(IN PREPARATION)

(IN PREPARATION)

Speeding

the Timetables of *INVASION*

Months ago a new and revolutionary tool of war . . . a giant troop and cargo transport named the Curtiss Commando . . . began to accelerate the timetables of invasion.

Today these great ships are swiftly spanning oceans and continents, transporting ever-increasing numbers of men, ever-mounting tons of supplies, to the theaters of action.

Commando performance in this new phase of military aviation has proved so effective that the U. S. Army has called upon Curtiss-Wright to devote facilities in four of its huge plants for the production of unprecedented numbers of these war giants . . . the world's largest twin-engined transports.

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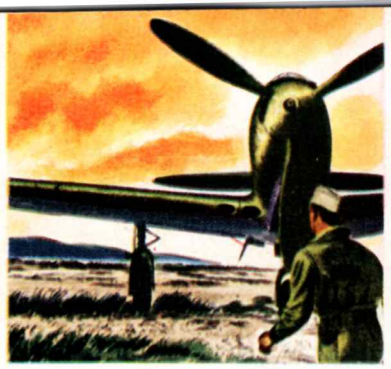
Member: Aircraft War Production Council, East Coast, Inc.

CURTISS *Commandos*
FOR CARGO AND COMMERCE

VAN SCOZZA

RUSSIA



NORTH AFRICA

THE SOLOMONS

ALASKA

PANAMA

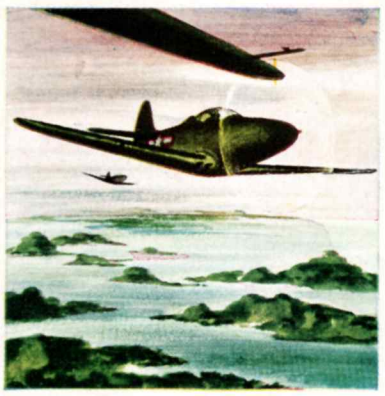
ENGLAND

AUSTRALIA

THE CARIBBEAN

ICELAND

NEW GUINEA



THE SOUTH PACIFIC

HAWAII

See why we build 'em fast?

At all these major bases and active fronts, U. S. Army Bell Airacobras are in the air day after day and week after week

More are being readied for action in secret sectors that will explode into fighting fronts as our offensive plunges ahead.

A good fighter plane is basic in modern strategy. The Airacobra is a tough, fast, versatile, single engine ship armed with heavy machine guns and a cannon. No battlefront ever has too many good fighter planes like the Airacobra.

See why we put design engineering on a production schedule, developed short cuts in fabrication and built moving conveyor assembly lines?

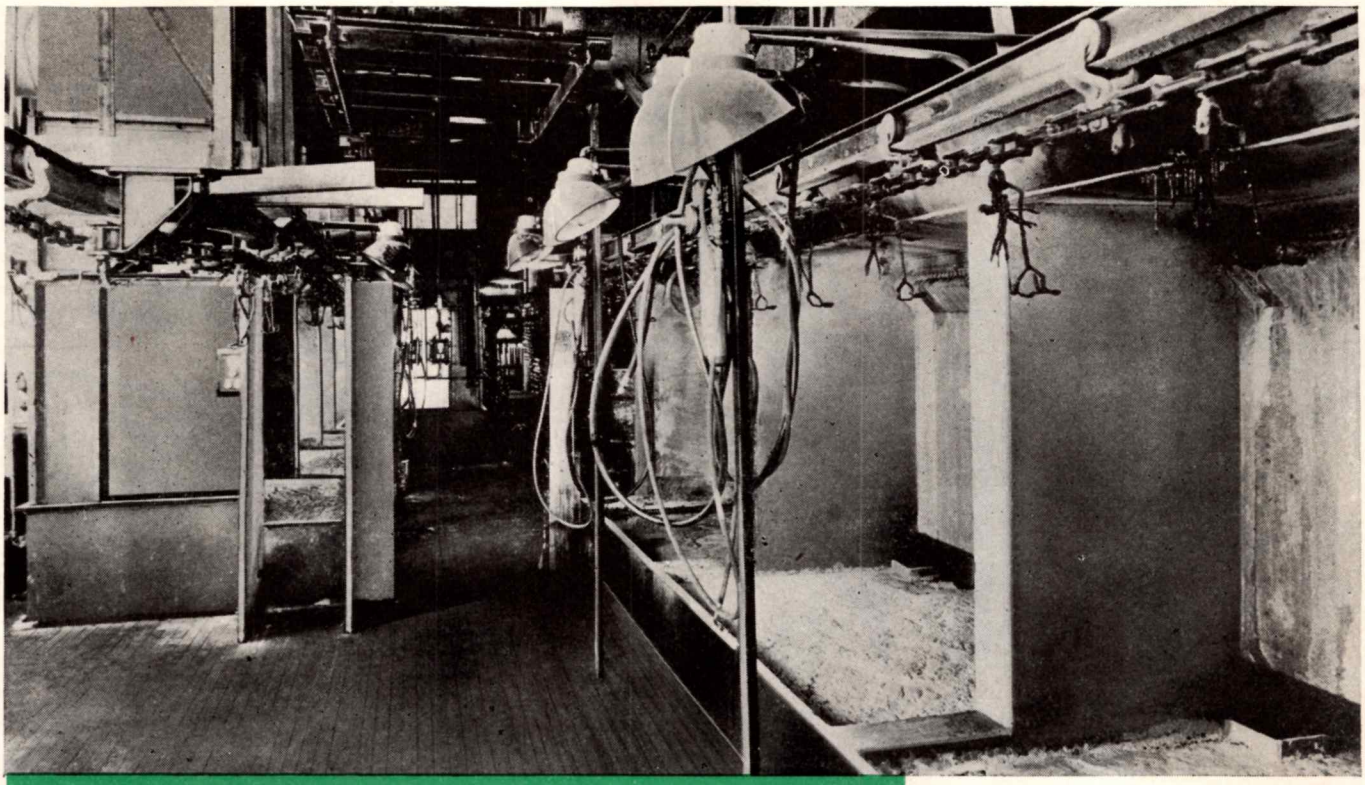
See why we must build 'em fast?

MASS PRODUCTION TECHNIQUES, developed to meet the demands of war, will be ready and waiting to build the planes of peace. That's one reason why your postwar aircraft will be far better, far lower priced than the types you knew before the war. © Bell Aircraft Corporation, Buffalo and Niagara Falls, New York.

BELL *Aircraft*

AIRACOBRAS for victory—future planes for peace

BUY WAR BONDS AND SPEED VICTORY



Typical finishing conveyor line. Collected overspray may be seen floating on the surface of water in tank

RECOVERY OF PAINT OVERSPRAY

S. DONALD PERLMAN

Chief, Chemical Resources Section
Industrial Salvage Branch, WPB

● The project of recovering the critical and strategic materials from wasted paint is part of the general program aimed at getting into the production stream all salvageable chemicals vitally important to the war effort. A nation-wide survey of the paint situation, made by the Industrial Salvage Branch of the War Production Board has shown that approximately 50 million lb of paint ingredients can be saved during the next twelve months, through cooperative action by the paint manufacturing industry and its consumers. The estimated quantities of the more important ingredients which can be reclaimed are as follows:

Pigments	29,573,000 lb
Phthalic Anhydride	3,576,000 lb
Glycerine	5,615,000 lb
Oils	2,825,000 lb
Zinc Yellow	1,630,000 lb
Damar Gum	1,330,000 lb
Glycarol Phthalate Resin	840,000 lb
Ethyl Cellulose	491,000 lb
Nitrocellulose	302,000 lb
Phenol Formaldehyde	245,000 lb
Alkyd Resins	238,000 lb
Chlorinated Rubber	236,000 lb

The supplies of these materials are limited, and their use in paints has been restricted, due either to more urgent wartime needs for them or for the basic raw materials used in their manufacture. The pigments, for example, contain metals such as chromium, zinc, lead and iron, which are used in the production of alloys. Phthalic anhydride, glycerine, formaldehyde and nitrocellulose are needed for explosives. The supply of vegetable oils is insufficient to meet our needs and those of the United Nations. The natural gums are imported principally from the Orient and Africa, and hence the supply is uncertain.

Most of the things that now come off our war industries assembly lines must be "mass-painted" by spray processes. This is where waste, usually called "overspray," occurs. It is known that about 30% of the paint used in these processes can be recovered by tested and effective measures. Satisfactory methods of reclaiming the collected overspray to yield a product equal in quality to the virgin material have been developed. In the few years since reclamation methods have been perfected, nearly 3 million gallons of paint have been reclaimed.

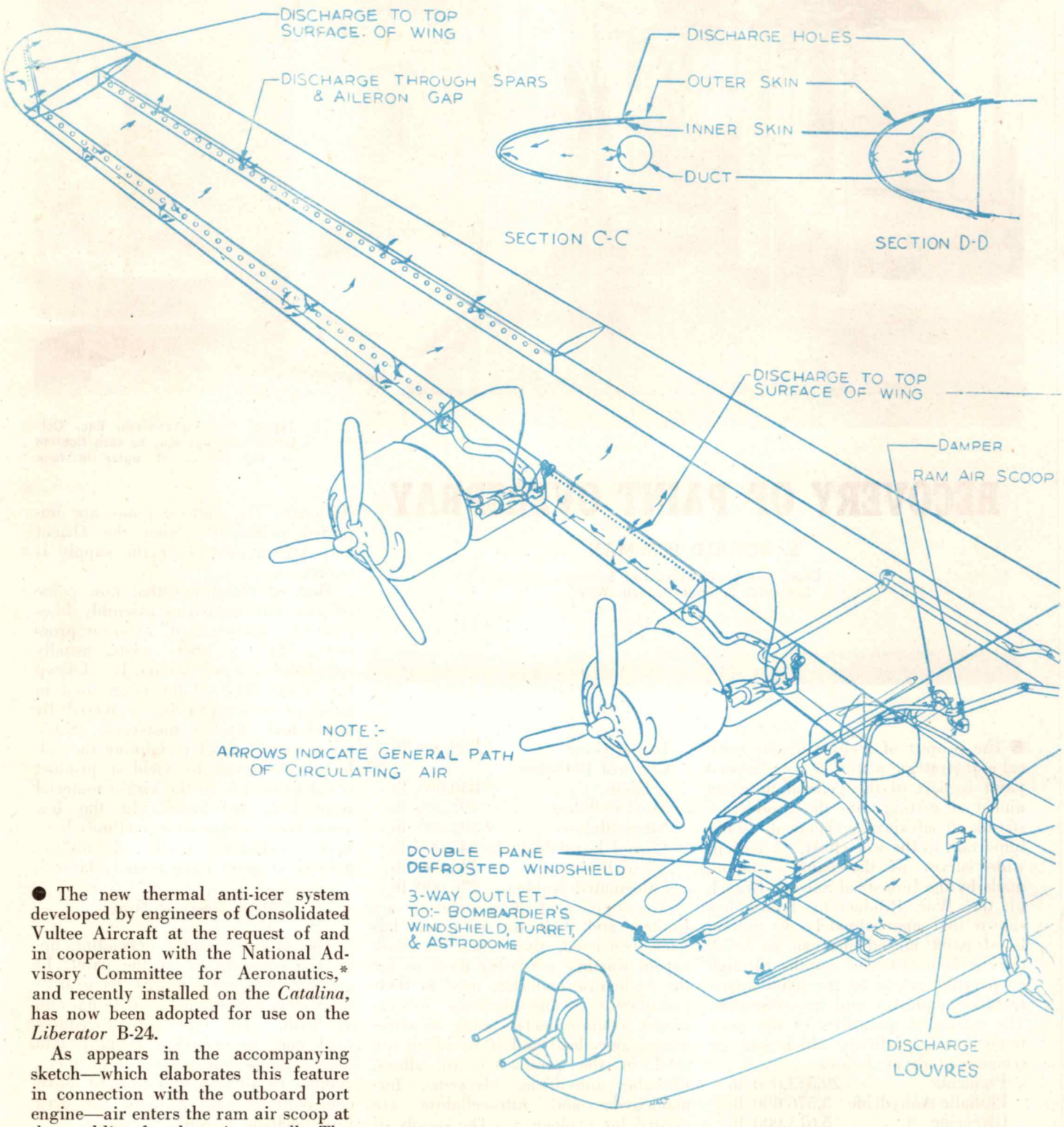
Three Groups of Steps

The processes vary, depending upon the composition of the paint. In general, the steps comprise removal of the water, redissolving, clarifying, and so forth. The types of procedures used may be classified roughly into three groups—one adapted to lacquers, another to oil base and straight alkyd compositions, and a third for urea formaldehyde finishes.

Probably the first thing to be done

(*Continued on page* 280)

THE "LIBERATOR'S" NEW THERMAL ANTI-



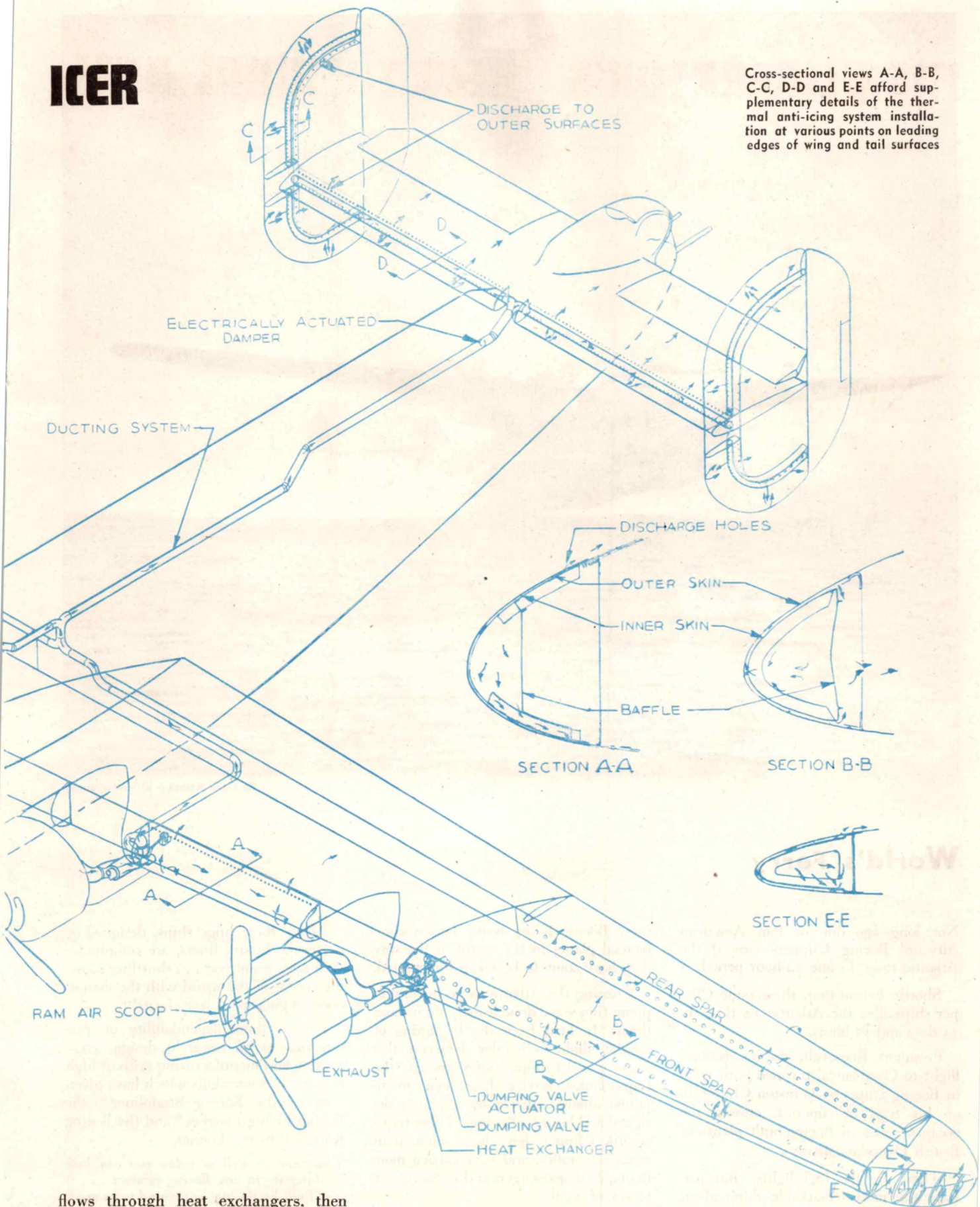
● The new thermal anti-icer system developed by engineers of Consolidated Vultee Aircraft at the request of and in cooperation with the National Advisory Committee for Aeronautics,* and recently installed on the *Catalina*, has now been adopted for use on the *Liberator* B-24.

As appears in the accompanying sketch—which elaborates this feature in connection with the outboard port engine—air enters the ram air scoop at the cowl lip of each engine nacelle. The air then passes through cross flow heat exchangers where exhaust gases at a temperature of approximately 1400°F heat the air to about 300°F. The heated air flows through a duct to the leading edge of the outer panel which serves as a static chamber, distributing air spanwise. From this chamber, the air passes through the inner skin, flowing chordwise through the wing to the rear spar where it is exhausted through the aileron gap.

From the inboard engines the air

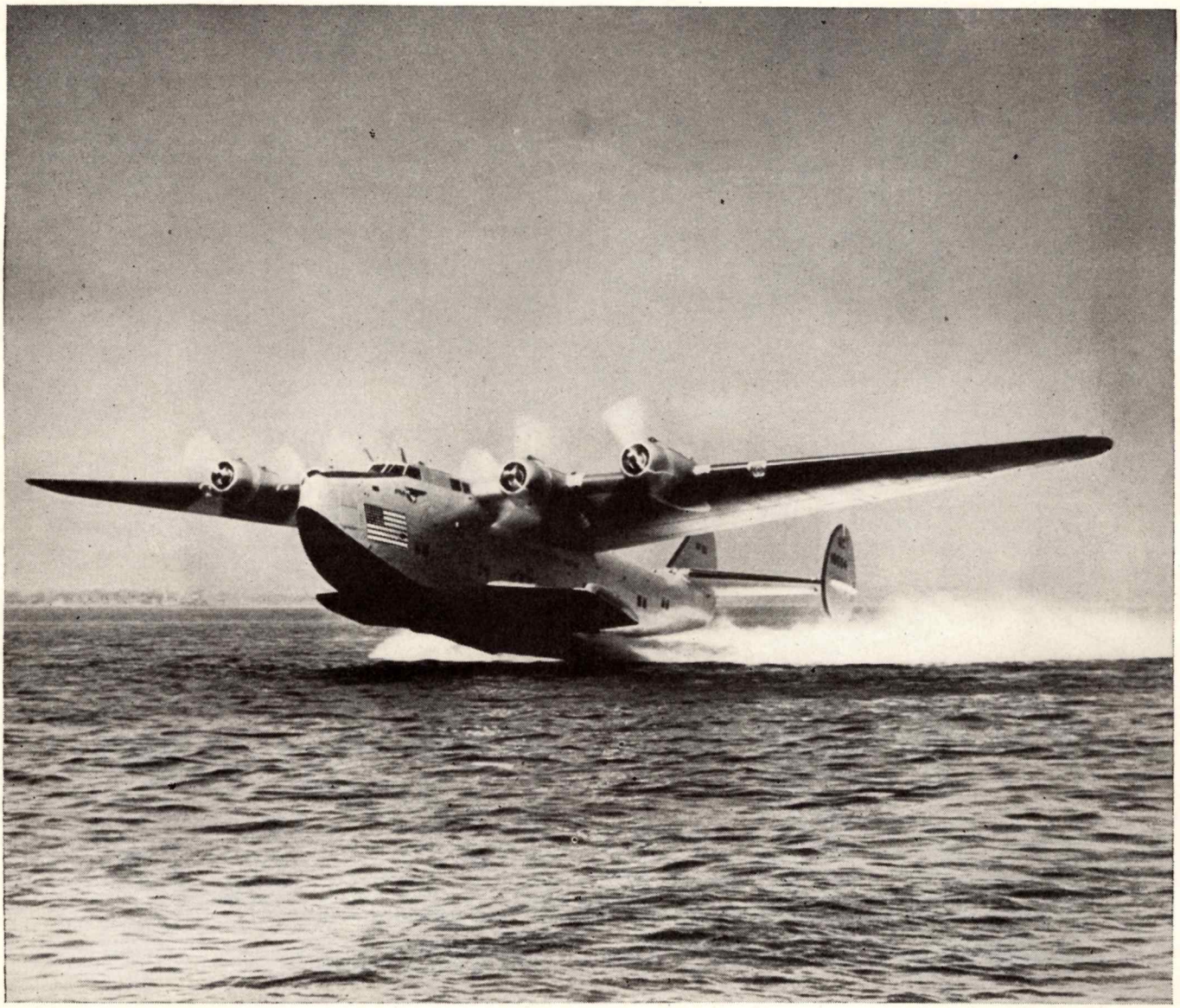
* See article in AERO DIGEST for September, 1943, page 225.

ICER



Cross-sectional views A-A, B-B, C-C, D-D and E-E afford supplementary details of the thermal anti-icing system installation at various points on leading edges of wing and tail surfaces

flows through heat exchangers, then through the leading edge duct. Because of the location of fuel tanks inside the wing, heated air from the wing center section is exhausted through holes on the upper leading edge. Part of the heated air from the inboard engines flows to the rudders and horizontal stabilizers to prevent icing on the empennage. Heat from the two inboard engines is used also in heating the flight deck and bombardier's compartment.



Back the Attack — with War Bonds

World's Ferry

Not long ago one of Pan American Airways' Boeing Clippers crossed the Atlantic *twice* in one 24-hour period.

Shortly before that, these same Clipper ships flew the Atlantic 12 times in 13 days and 15 hours.

President Roosevelt, on his historic flight to Casablanca, traveled both ways in Boeing Clippers. Winston Churchill, on his trips to America, crossed the ocean 6 times in Boeing-built planes of British Overseas Airways.

These are the high-lights. But perhaps the most remarkable thing about these Boeing flying boats, largest commercial planes in the world, is the way they have come to be taken for granted.

Crossing the Atlantic is no novelty to them; they have done it more than 1400 times! In fact, from the beginning of regular flight schedules between this country and Europe four years ago, the transatlantic service has been maintained almost entirely by airplanes designed and built by Boeing. These transoceanic Clippers have flown more than 7,000,000 miles, and have carried more than 44,000 passengers and 100,000,000 pieces of mail.

Today these huge ships, designed as peacetime luxury liners, are completing vital missions of war . . . shuttling across the oceans of the world with the monotonous regularity of *ferry boats!*

Behind their dependability of performance stand research, design, engineering and manufacturing skills of high degree, the same skills which have given America the Boeing Stratoliner,* the Boeing Flying Fortress,* and the Boeing Kaydet Primary Trainer.

Tomorrow as well as today you can look for integrity in any Boeing product . . . if it's "Built by Boeing" it's bound to be good.

DESIGNERS OF THE FLYING FORTRESS • THE STRATOLINER • PAN AMERICAN CLIPPERS **BOEING**

*THE TERMS "FLYING FORTRESS" AND "STRATOLINER" ARE REGISTERED BOEING TRADE-MARKS

MARTIN "MARS" GOES TO NAVY

● The seventy-ton Martin *Mars*, world's largest flying boat, has been turned over to the Navy Trial Board following completion of a series of gruelling tests. Upon verification of the test results by the trial board, the *Mars* will enter the Naval Air Transport Service as a "flying Liberty ship", carrying men and materials to distant war theatres.

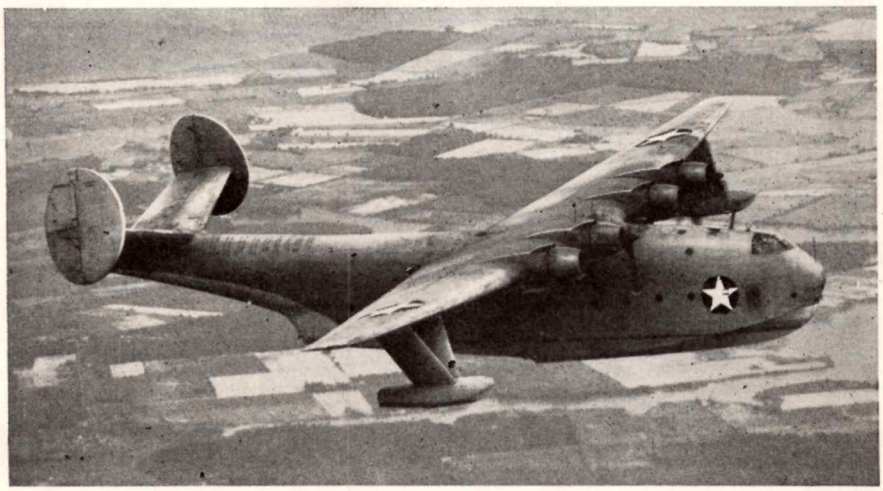
On its last few flights the *Mars* demonstrated to the satisfaction of company engineers that it was everything they had claimed. In a 32-hr, 17-min non-stop, non-refueling endurance flight, during which it traveled more than 4600 miles, the big flying boat exceeded the international closed-circuit distance record for seaplanes by some 50% and bettered three other official records.

At an altitude of more than 13,000 ft, to meet Navy requirements, the *Mars* went into a power dive, the accelerometer registering 3 g's at the pull-out. This figures out to a wing load of approximately 210 tons.

On the unofficial side, the *Mars* set new standards also: (1) for gross load at takeoff—leaving the water at 141,000 lb; (2) for size of crew on an endurance flight—there were 22 persons aboard; (3) for amount of fuel carried—it had approximately a tank car load aboard at takeoff; and (4) for longest sustained flight over water. In addition the aircraft established what are believed to be new non-refueling endurance marks for seaplanes, for four-engined planes and for airplanes of over 30,00 lb gr wt.

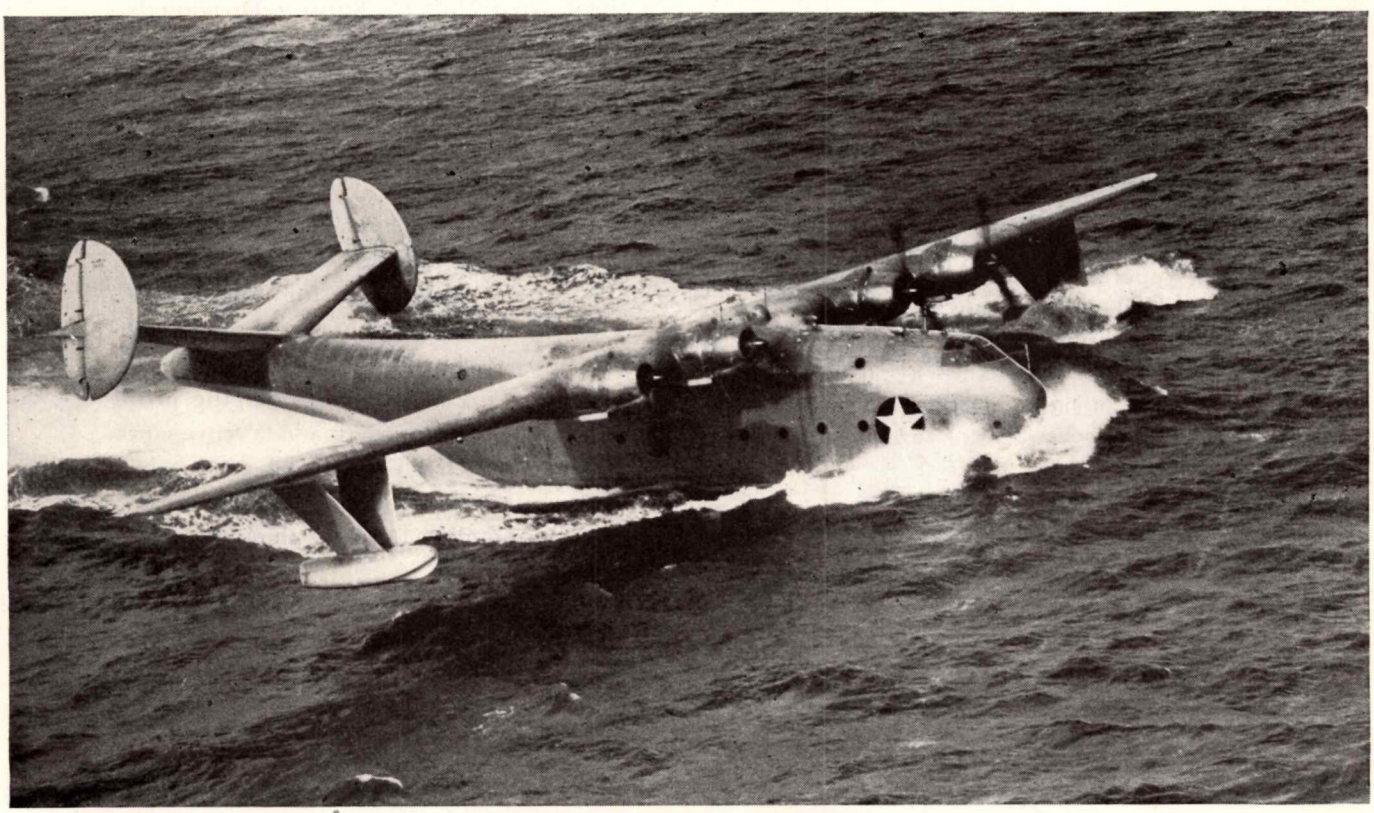
The *Mars** has a wing spread of 200 ft and measures 117 ft from stem to stern. Powered by four Cyclone-18 engines, delivering 2000 hp each, it can carry in excess of 15 tons of cargo.

* *See article in August issue of* AERO DIGEST, *page 194, for full description of this airplane.*



When final test flight is confirmed, the "Mars" will see service as a cargo carrier

Heavy seas fail to bother the 70-ton Martin "Mars" as it taxies along Chesapeake Bay in water too rough for the average seaplane



The STINSON RELIANT

Classroom of the R.A.F.

REMOVE the gray-green battle dress of the R.A.F. from the plane pictured above and you might easily recognize the famed Stinson "Reliant" of pre-war days. This plane, produced by Stinson Aircraft at Wayne, Michigan, was pridefully owned by hundreds of American businessmen and sportsmen, and used by every major American airline for blind flight training. Today, stripped of all its pre-war luxury refinements, the "Reliant" is doing yeoman duty as a "flying classroom" in the Royal British Navy. Hundreds upon hundreds of pilots, observers, radio operators and navigators now flying giant Consolidated "Catalinas" and British Short-Sunderland patrol bombers learned their flying ABC's in this ship which is being turned out in ever increasing quantities by Consolidated Vultee's famous Stinson Division at Wayne, Michigan.

A heavy bomber is an expensive classroom. Most of them are needed over Germany and Japan where there is no room for the novice. That's why training plane production is most vital; that's why you can be sure that Consolidated Vultee's Stinson Division is sparing no effort to get more and more, and still more of these fine navigation trainers into the capable waiting hands of British flyers. At McAleer, we are privileged to add our skill and knowledge as well as our highly developed manufacturing facilities to this effort as we work day and night to build surface assemblies for the AT-19 Trainer. By accepting our share of the responsibility to those brave British lads who will train in the ships we are helping produce, we feel we have made a covenant with them which will not and cannot be broken until the United Nations are successful in producing a peace that *must* be permanent.

McAleer
MANUFACTURING CO.

Manufacturers of Quality-Controlled Finishing Materials, Military Aircraft Sub-assemblies and Pyrotechnics . . .

ROCHESTER, MICHIGAN

The CORNELIUS Flying Wing

Experimental Model of a Modified Design with Sharp Forward Sweep to Wings Indicates Practical Solution to Flying Automobile Problem

DEVELOPMENT of a modified flying wing type of airplane whose wings have a sharp forward sweep, and which indicates a practical solution of the flying automobile problem has been disclosed by George Cornelius, president of the Cornelius Aircraft Corp., Dayton. An experimental model has been built and subjected to protracted tests over the past three years. It was recently flown successfully at Dayton.

In addition to the distinctive forward sweep of the wings, a striking feature of the Cornelius design is the mounting of the wings on two "rotation members" which extend from the fuselage into the wing panels. This construction provides a means for varying the angle of incidence of the wings, and this feature together with the forward sweep of the wings effects a degree of stability hitherto not realized in this type of airplane, according to the designer.

The design eliminates the conventional empennage, of course. The ability to vary the angle of incidence of the wings does away with the elevator, and the fin and rudder are placed on the wings proper.

A high load factor was used in this airplane so that experimental changes could be made without impairing the airworthiness of the structure which is of steel tube construction with wood ribs and fairing, fabric covered. A fixed type landing gear with unusually large wheels and robust members is employed, so as to withstand rough usage in testing. The fuselage is 52 in wide to provide ample room for flight crew and test equipment. Other dimensions are:

Gross weight	2472 lb
Useful load plus test equip.	600 lb
Wt. empty	1872 lb
Wing area	206 sq ft
Wing span	30 ft
Wing aspect ratio	4.28
Wing loading	12 lb
Aileron area (entire movable wing panel)	65 sq ft
Elevator,* (entire movable wing panel)*	65 sq ft
Fin and Rudder	25.75 sq ft
Center section area	76 sq ft
Engine	165 hp
Max. speed, (fixed landing gear)	140 mph
Cruising speed	125 mph
Stalling speed	45 mph
Service ceiling (est)	16,000 ft

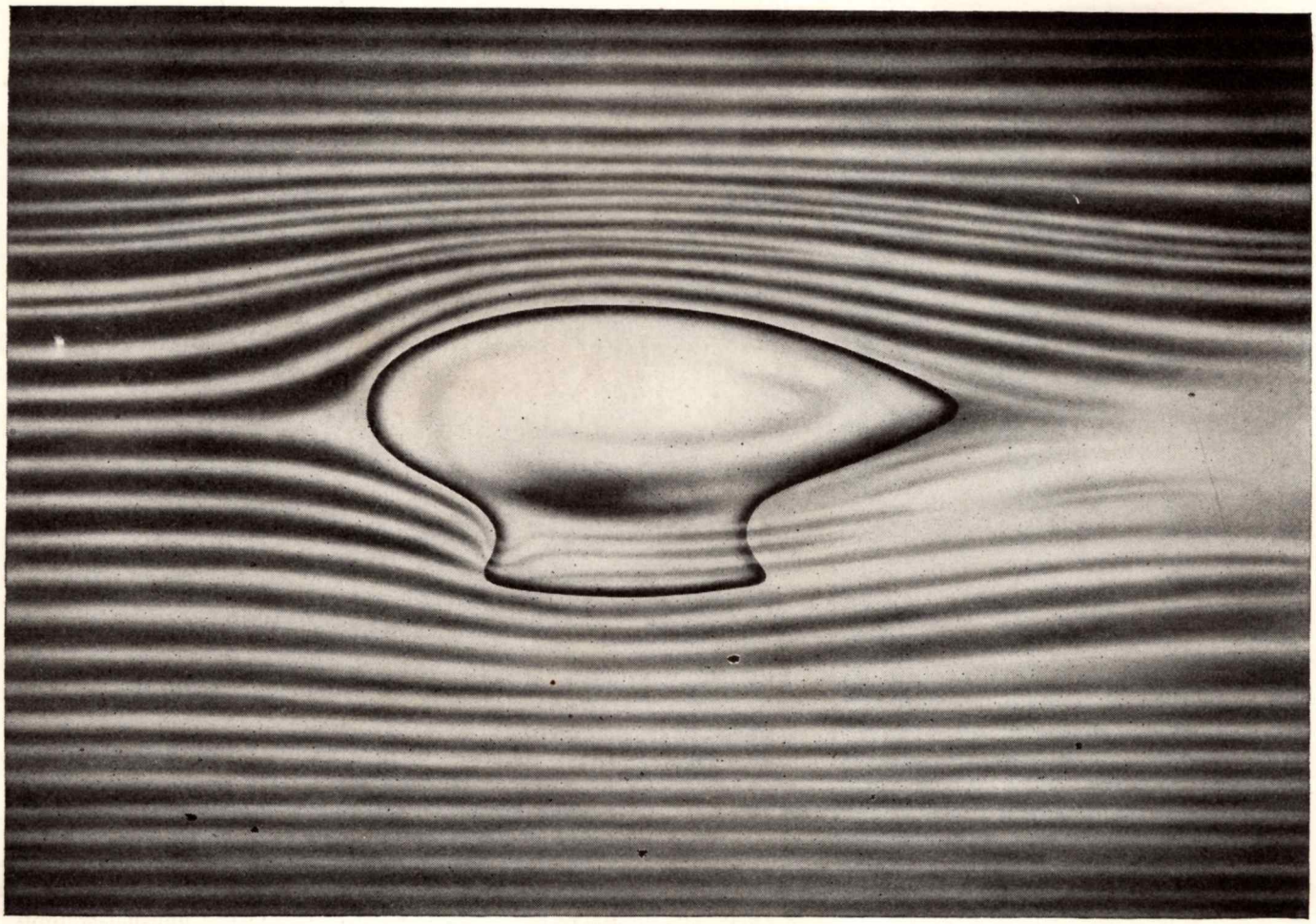
While the illustrations of the model, which was built and flown for research purposes, show the airplane with the variable incidence wing feature, it was also designed to fly with fixed wings, as the movable wings can be bolted in a fixed position. Because of these exploratory features and research equipment, the original plane was overweight by as much as 700 lb. This original modified flying wing proved the aerodynamics of the new design to be basically sound. The unusual stability of the design was further demonstrated by constructing and towing gliders without pilot or other control means. These gliders had sufficient stability to take off and follow, in tow, through turns, climbs, descents and landing with the controls in a fixed position. Pitching and yawing were found to be negligible in rough air.

**Note: The outboard movable panels function both as aileron and elevator.*

Data from Towed Flight

Sufficient data have been obtained through towed flight to more than prove the practicability of this type of plane as a cargo carrier in airline operations, and at cruising speeds comparable to those of high performance airplanes. For example, gliders of this type were towed with simulated wing loading of 40 psf. The airplane would take off with a pilot at the controls of the glider and as soon as he had trimmed the glider for the desired altitude and cruising speed, he would then lock the controls in a fixed position until the signal for landing was given, at which time he would take over again. The combination of the forward wing sweep and the variable angle of incidence makes possible an overall higher lift because the outboard wing panels assume a higher angle of incidence, and produce a stalling mo-

(Continued on page 277)



Streamlined!

THE principles of streamlining are clearly evident in every speedy bird and fish. Yet thousands of years passed before man perceived these principles and applied them to boats and vehicles. With the high-speed airplane, streamlining came into its own. Exposed surfaces began to be scientifically shaped and finished so that the air-stream would flow around them with least resistance, less drag. Less drag, of course, means higher efficiency, more speed. In a combat ship it may mean the difference between life and death.

Smoke tunnel tests, as illustrated above, guide the engineers in the development of streamlining to reduce drag and turbulence. When loop antennas were first used on aircraft, flying speeds were low—the relatively high drag of an open annular (doughnut) loop was unimportant. As speeds increased, this drag became a serious handicap. Realizing the gravity of this problem, RCA engineers early in 1935 began tests on a streamlined housing with an internal loop. Today, wind-tunnel tests show that at very high speeds, an RCA streamlined loop has an extremely small drag. The loop can be turned freely without affecting the aerodynamics of the plane. Accurate bearings can be taken; remote control is simplified.

RCA Aviation Radio Equipment is the net result of engineering initiative, ingenuity, and exhaustive research at every stage of theory, design, and manufacture.

RCA

BUY WAR BONDS

RCA AVIATION RADIO

Radio Corporation of America, Camden, N. J.

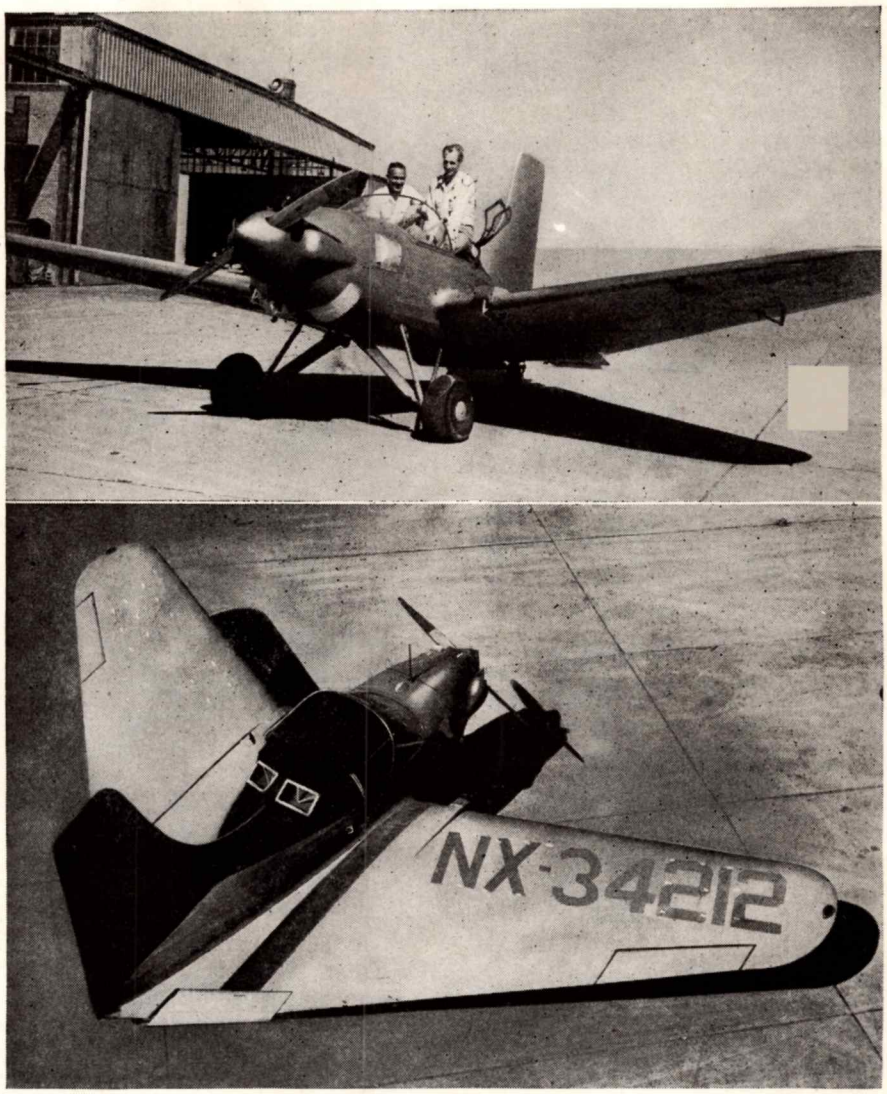
(Continued from page 275)
ment without the resulting loss of lift usually encountered when elevators are deflected upward on the trailing edge of a wing to accomplish the same purpose.

In the fixed wing type of plane a gust usually displaces the entire airplane, but in the variable incidence type the wings automatically change their angle to absorb or offset the unbalancing forces. The variable incidence wings, having a much smaller moment of inertia and being aerodynamically balanced on their respective mountings, reduce the stress normally imposed and prevent a sudden displacement of the airplane from its flight path.

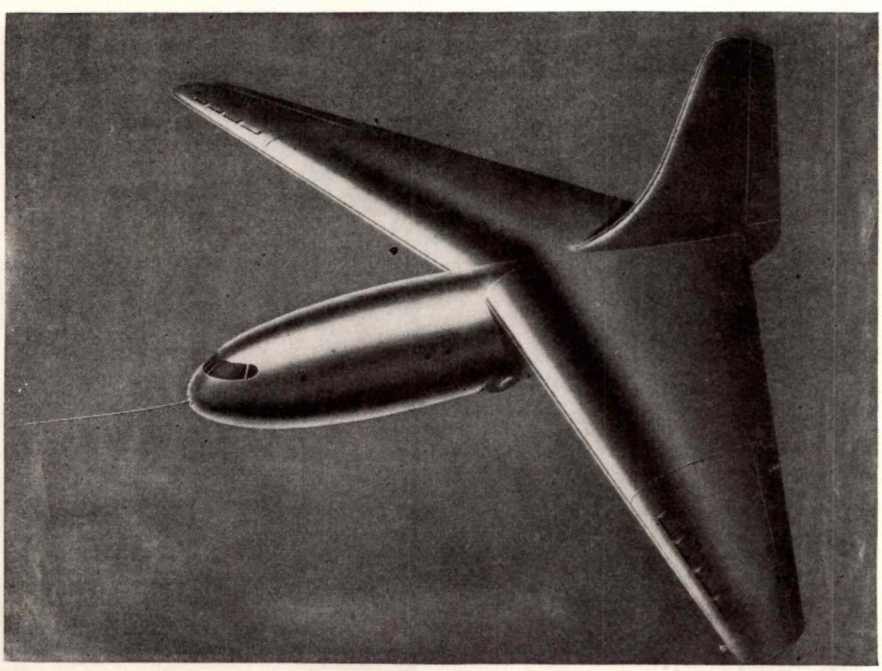
Impossible to Stall

The designer points out that it is physically impossible to stall this airplane, because, as the stall speed is approached, the wing panels automatically reduce their angle of incidence and impose excessive forces on the control beyond the power of the pilot to hold. The inertia of the wing panels being so much less than that of the fuselage and center section, the recovery is virtually instantaneous and complete. This feature of self-adjustment makes this design foolproof as far as stalling and uncontrollable attitudes are concerned.

According to the designer, the forward sweep of the wings eliminates the usual difficulties encountered with tail groups, such as tail flutter resulting in structural failure, and thereby enhances both the efficiency and safety. Sweeping the wings forward also causes the air to flow slightly inwardly, whereas sweeping the wings to the rear causes the air to flow away from the fuselage. The result is that at the stall, the wing tips of the Cornelius design do not stall out before the rest of the wing. With the rearward sweep design, on the other hand, the wing tips tend to stall before the rest of the wing. It was found in actual tests that the controllability or maneuverability at the stall speed was extremely good. The forward sweep of the wings has an important advantage in preventing the airplane from nosing over in case of ground accidents. For example, if the nose wheel of the tricycle landing gear were to fail while landing, the wing tips striking the ground would resist any tendency on the part of the airplane to roll over.

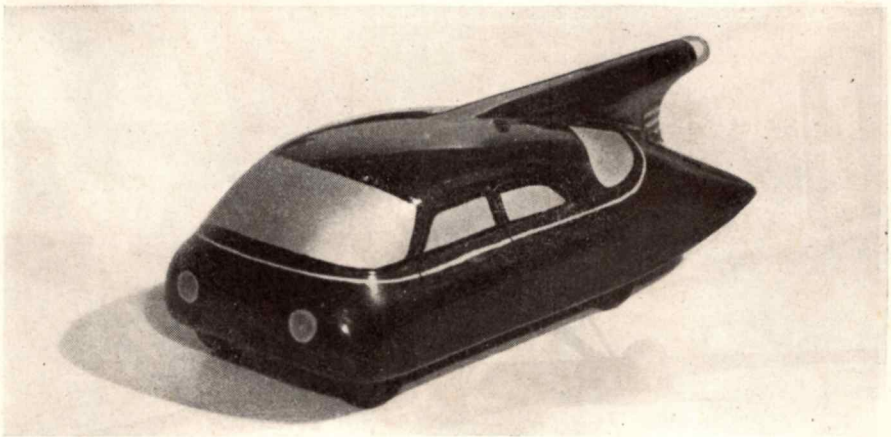


Upper: George Cornelius (left) inventor, and Alfred Reitherman, test pilot. Lower: Modified flying wing aircraft. Below: Conception of cargo glider of future

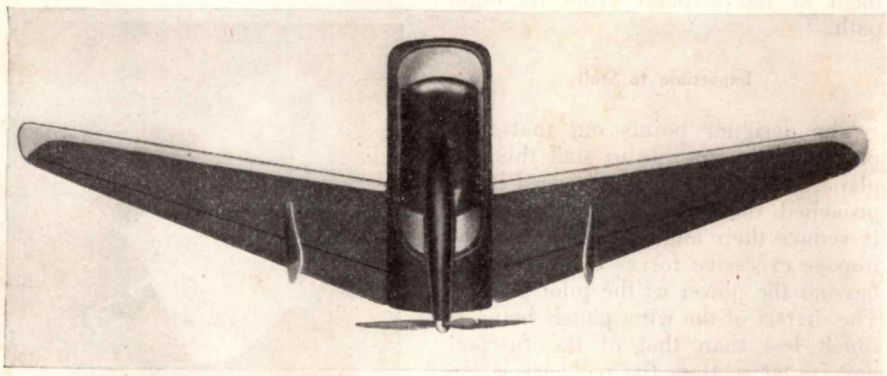


Two Other Planes Projected

Two other fixed wing airplanes of the modified flying wing type are now projected by Cornelius. One is of the single seat tractor type which can be used for liaison work, and the other is a flying automobile. Cornelius estimates that the liason type will have a



Above: Model of flying automobile as it will be used on the streets. Right: With rented wings and propeller attached—same car ready for flight



gross design weight of around 1400 lbs and will carry a useful load of about 290 lbs. A wing area of 140 sq ft is projected, which is based on a wing span of 34 ft 2 in and a wing aspect ratio of 7. Wing loading will be close to 10 psf. Maximum speed, with a 130 hp engine turning over at 2550 rpm, is figured at 144 mph and the cruising and landing speeds at 130 mph and 50 mph, respectively.

A total distance of 800 ft will probably suffice in getting this aircraft into the air and this is divided into 368 ft for the takeoff, 136 ft transition distance and 296 ft to clear a 50 ft object. The best climb angle, at 68 mph, is estimated at 9.6° while at 90 mph a sea level rate of climb of 1180 fpm is anticipated. The higher speed would afford a rate of climb of 600 fpm at 10,000 ft and 360 fpm at 15,000 ft altitude. A service ceiling of 18,600 ft and an absolute ceiling of 20,400 ft are projected for this design.

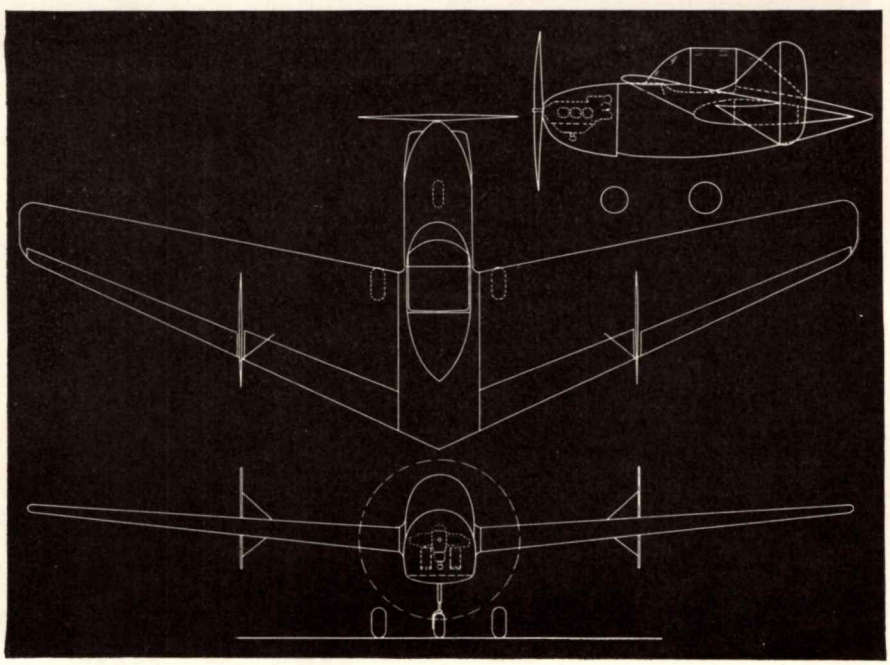
Suitable for Small Fields

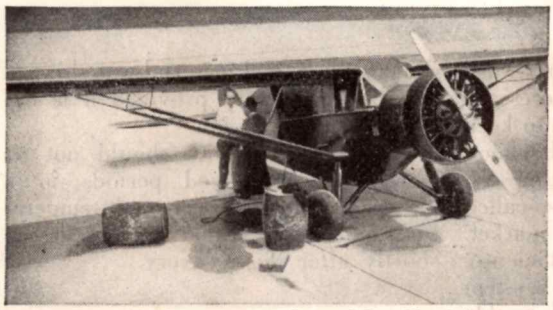
Such performance would make the plane suitable for small landing fields. Cornelius has worked on the design of flying automobiles for many years and has never felt that the idea was wholly practical in previous attempts. In his opinion, however, the forward sweep wing is undoubtedly the solution to the problem of dual means of transportation. Among the reasons for this conclusion are: inherent stability; compactness of design; and ease of conversion to airplane or back to automobile because there is no tail group to contend with. Furthermore, no radical change in automobile design is necessary with the exception of reduction in weight. Visibility with this design is of a high order, for the rear passengers sit on the exact center of gravity and this puts all the passengers in front of the leading edges of the wings. Small size of wing panels comprising the lifting and control surfaces facilitates their handling and storage when not in the air, and their inexpensiveness makes possible a nationwide wing rental service at low cost.

In other words the owner of a convertible automobile could fly to the nearest airport, rent a pair of wings and propeller, fly to the airport of any other city, check his wings and propeller while doing business in that city and pick them up for the return journey. Or, he could drive to another city where he might decide to continue his journey with another set of rented wings and propeller, the idea being that no matter how extended his trip or how many cities he visited, he would never be encumbered with wings or propeller when motoring along the highway, and they would always be at his disposal, when he wanted to fly, at the point of takeoff.

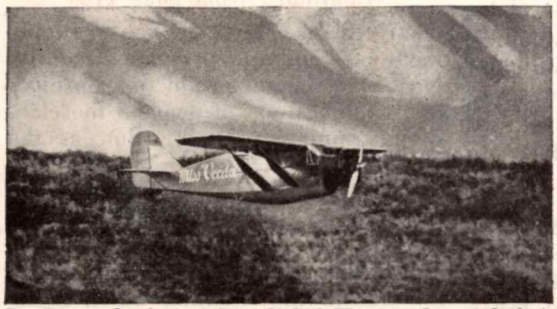
Such a service could also provide a close check on the airworthiness of each unit which would be a safeguard both to the owner and the public. Sales of flying automobiles through this conversion feature, would be handled through dealer organizations similar to automobile distributors, etc.

Three-view outline drawing of the modified Cornelius flying wing





Fueling the Bellanca monoplane, Miss Veedol, at the start of the round-the-world flight of Clyde Pangborn and Hugh Herndon, Jr. They took off from Tokyo October 4, 1931, en route to the U. S. A. non-stop.

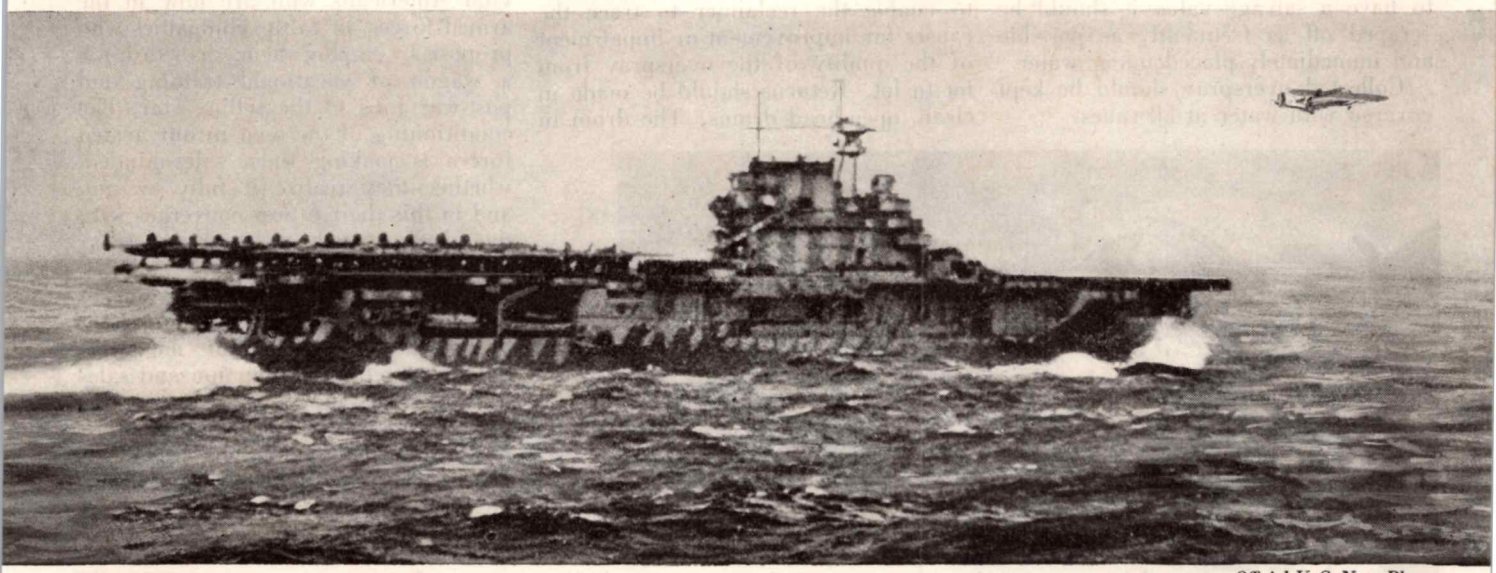


Perfect end of a perfect flight! Having dropped their landing gear at sea to gain speed, Pangborn and Herndon are pictured about to land at Wenatchee, Wash. They flew 4,558 miles non-stop in 41 hours.

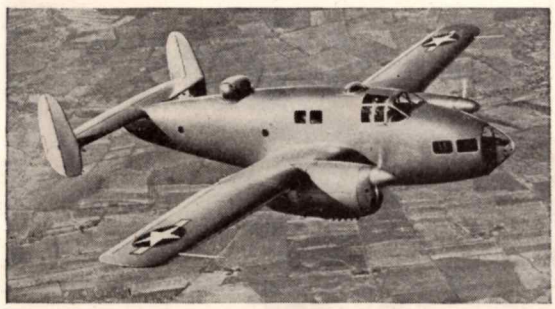
NO JAP EVER "HOPPED" THE PACIFIC

Tojo thought that treachery would take the place of skill, but he was wrong. There's no substitute for aeronautical pioneering ability! The Japanese never have caught up with the performance record of the 1931 American plane which took off from Japan and flew non-stop to the United States twelve long years ago.

In fact, no other airplane has ever duplicated that Pacific flight in the long-distance Bellanca cabin monoplane, Miss Veedol. But today thousands of American flyers are sweeping the Pacific north and south, east and west. They are flying many types of rugged American-built aircraft. They are matching the inspiring intrepidity of the men who flew that glorious assault on the enemy's homeland in the Army Air Forces B-25s shown in this photo of the U. S. S. Hornet.



Official U. S. Navy Photo



The AT-21-BL gunnery crew trainer, in production at Bellanca Aircraft Corporation for the United States Army Air Forces.

First to link Japan and America by air non-stop, Bellanca today contributes to the crushing of Japanese military power. Many of the United States warplanes, roaring to Victory, carry armament equipment and aircraft components precision-built at the Bellanca plant, where the AT-21-BL gunnery crew trainer is in production.

KEEP ON BUYING U. S. WAR BONDS

BELLANCA AIRCRAFT CORPORATION

NEW CASTLE, DELAWARE

PAINT OVERSPRAY

(*Continued from page* 269)

is to educate the personnel of the finishing department to regard the overspray as a valuable material. In the past, paint overspray collected in water wash spray booths has been commonly referred to as "sludge," a waste product which was discarded.

Only one type of paint should be sprayed in a water-wash recovery unit. Contamination of paint overspray with foreign materials must be avoided. Metal objects, such as conveyor hooks, spray nozzles, bolts and nuts are apt to damage reclaiming machinery. Extreme care should be taken to prevent paper or cardboard from getting into the collected overspray.

Dried overspray, such as scrapings and sweepings from the dry parts of the booth, should not be added to the water-wet overspray which is to be reclaimed. In rare instances, where a relatively non-oxidizing finish is sprayed, the dried overspray may be reclaimable into usable material. Where such overspray has been found to have a salvage value it should be scraped off as frequently as possible and immediately placed under water.

Collected overspray should be kept covered with water at all times.

In the operation of a water-wash spray booth, it is generally necessary to add a chemical to the water to keep the overspray from fouling the flood sheet, nozzles, and the circulating system. There are a number of so-called spray booth compounds on the market. Although these may function efficiently in keeping the spray booth system clean, they may not yield a reclaimable material. The choice of a suitable recovery medium can be determined by trial in each case.

The following general principles should cover the use of overspray recovery agents: (1) use the minimum amount necessary to keep the spray booth system clean and to yield a reclaimable material; (2) keep a record of additions of compound and of the alkalinity of the water — determined simply by adding two drops of Eimer & Amend B.D.H. Universal Indicator to about 20cc of solution, or by means of a Fisher alkacid tester ribbon; (3) this data should be tied in with the removal of the various lots of overspray, the purpose being to enable the reclaimer to trace the causes for improvement or impairment of the quality of the overspray from lot to lot. Returns should be made in clean, open-head drums. The drum in which the original material was shipped will be satisfactory provided it is uncontaminated.

Collected overspray should not be stored for prolonged periods in a place that is above normal temperature, and it is best that it be processed shortly after the recovery.

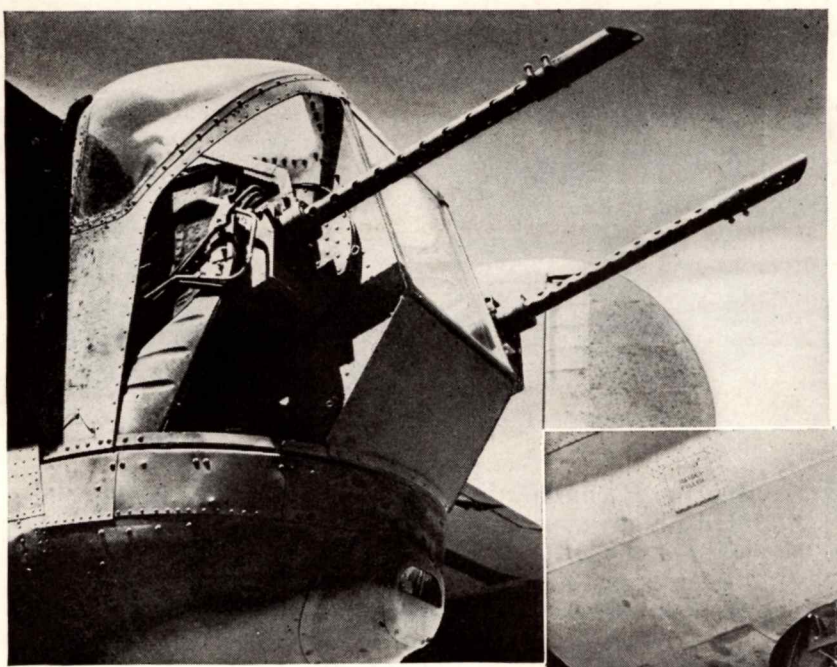
FROM UNIFORMS TO WHAT?

(*Continued from page* 115)

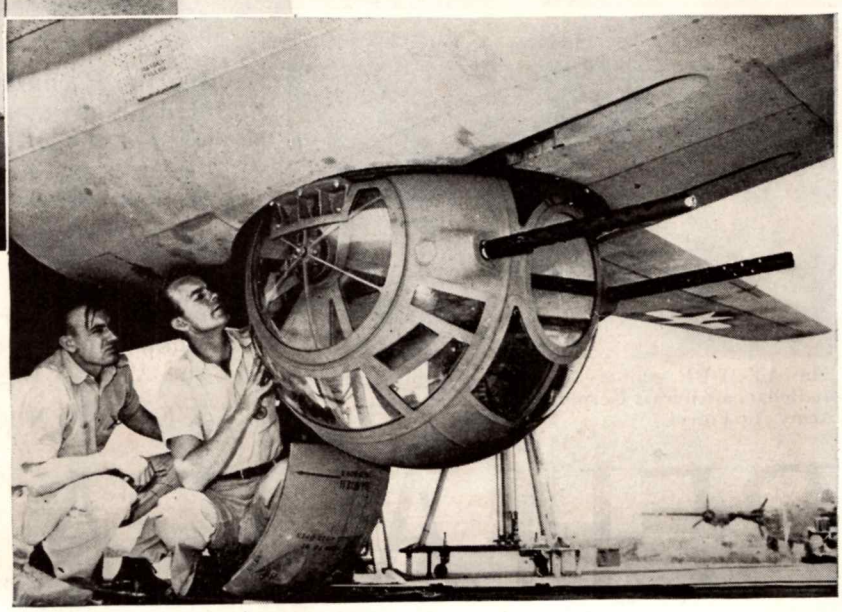
ductive plant is large enough to supply the tools, and the personnel requirements for general production on modern machines do not demand too elaborate training anyway. But, as the crux of the problem is to sell and distribute the output of these plants in the post-war world, the emphasis in vocational training should be put on *reemployment in selling*. That is the side of the equation which needs to be bolstered, for on it the support of all jobs must ultimately depend.

Nothing can be more useful to these vital Americans who are now in the armed forces, or to the companies who propose to employ them, than to hitch a wagon of vocational training and post-war jobs to the selling star. The conditioning of the men in our armed forces is making them sales-minded, whether they realize it fully or not, and in this their fitness converges with the basic need of our post-war economy.

Great salesmen are coming out of this war—by the hundreds and hundreds of thousands. Our men will hit the target for production and sales jobs alike as they hit the target for war. And in this fact is the most promising single ingredient for a better world at home and abroad. Nothing will stop our men when they come home.



Above: Close-up of Consolidated-designed power tail turret of a "Liberator" bomber, showing its two .50 cal machine guns



Right: Retractable Sperry ball turret replaces an older model in belly of a "Liberator." This bomber is now equipped with four turrets and five fixed guns, accounting for thirteen .50 cal machine guns in all

Outward Bound!

A "Dauntless" takes off on AEROLS*

Nemesis of the nipponese navy, the Douglas "Dauntless" is one of the world's hardest hitting dive bombers.

Because this outstanding plane is equipped with Aerols, it performs with effortless ease the exacting job of taking off or landing on an aircraft carrier.

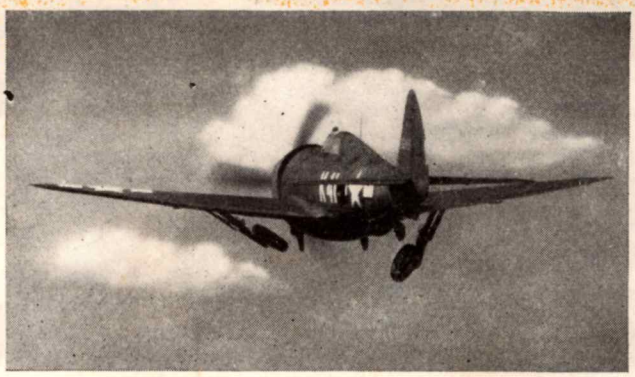
Aerols for the "Dauntless" and other aircraft are pouring in ever increasing quantities from our production lines. Our new plant is the largest in the world solely devoted to the manufacture of this essential aviation product.

CLEVELAND PNEUMATIC AEROL, INC.
Wholly owned subsidiary of The Cleveland Pneumatic Tool Co.
EUCLID 17, OHIO

AEROLS*

*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR; THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL"—THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS

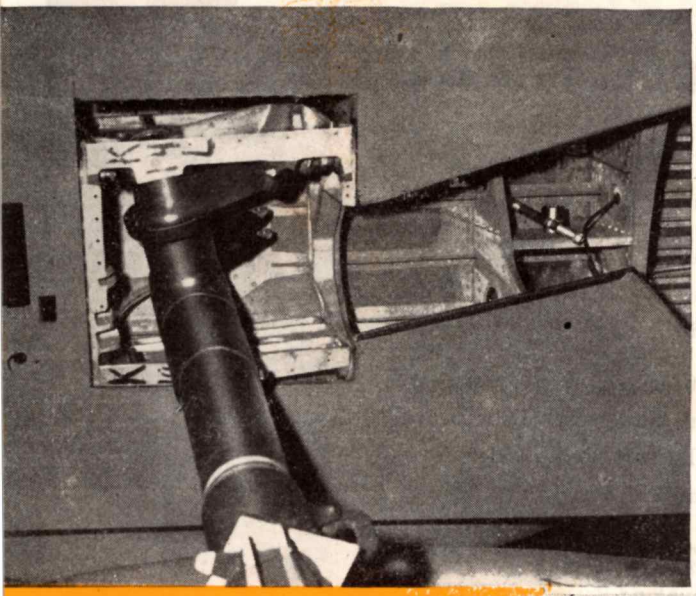
Right: "Thunderbolt", after takeoff, showing partly retracted landing gear

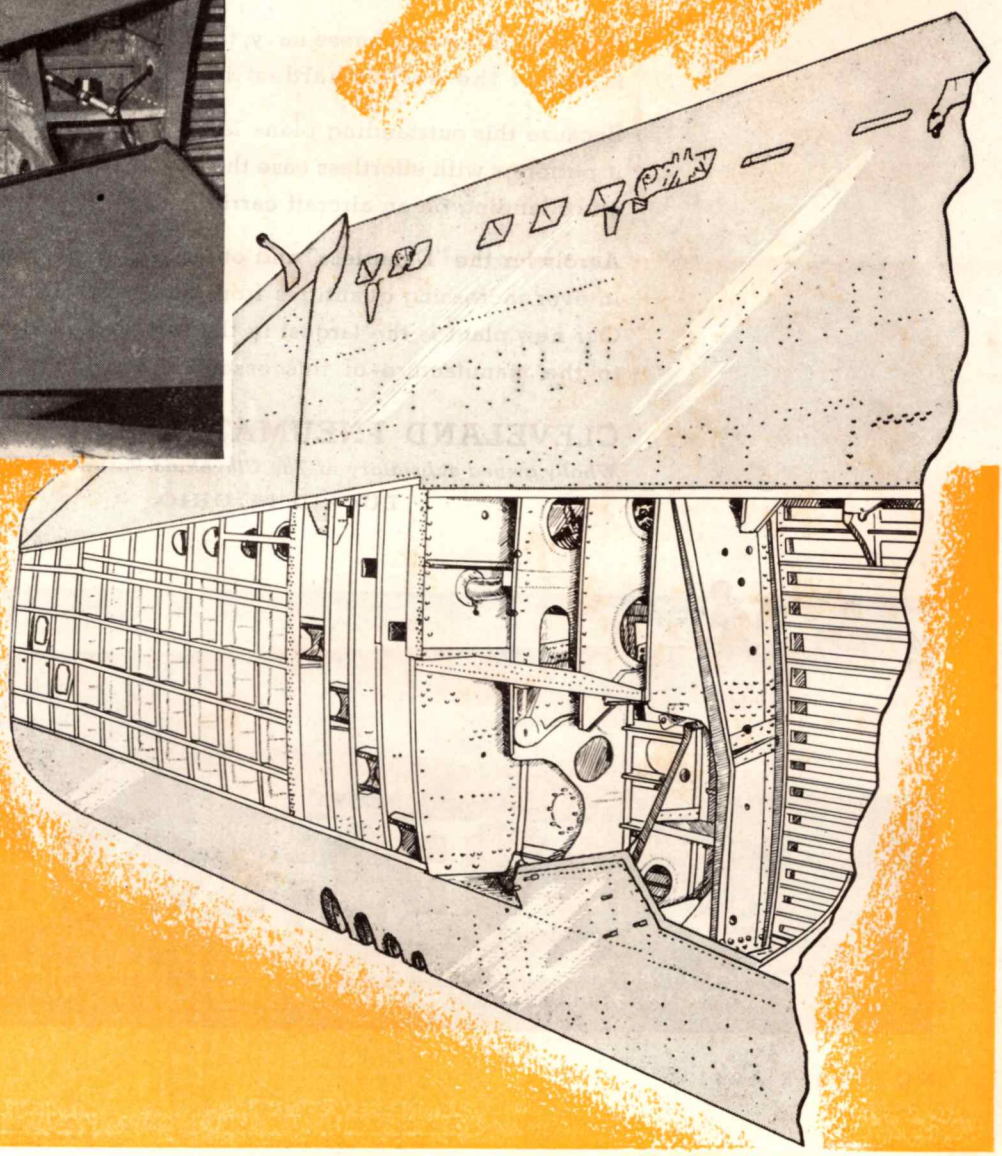


Above: Landing gear in fully extended position

REPUBLIC P-47
THUNDERBOLT

LANDING GEAR

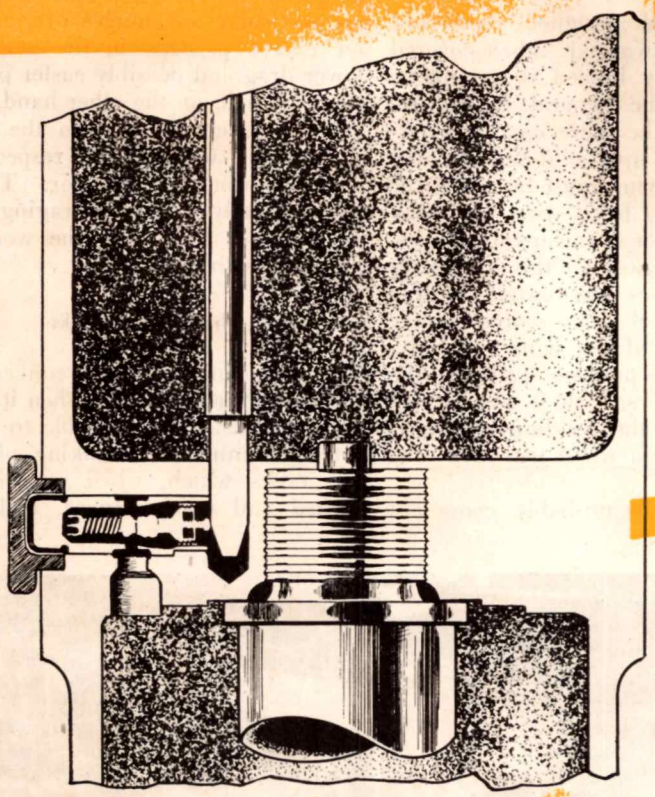




Above: Detail showing design relationship of P-47's landing gear strut and structural components of wing. Right: Line drawing of under part of wing foreshortened, showing location of landing gear well and other construction features

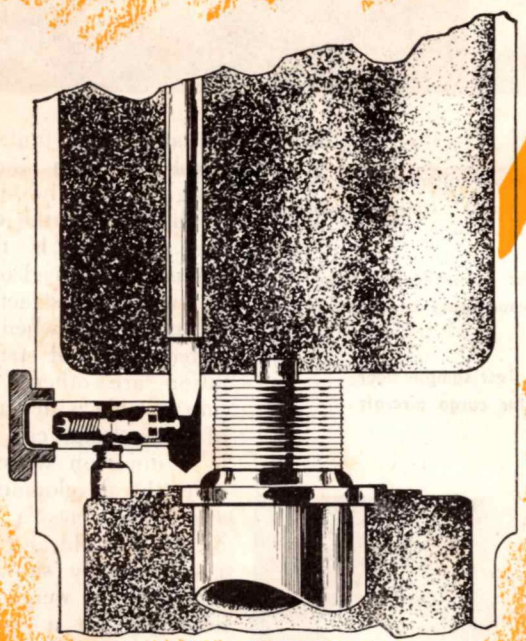
PORTFOLIO OF DESIGN FEATURES

PARTLY RETRACTED

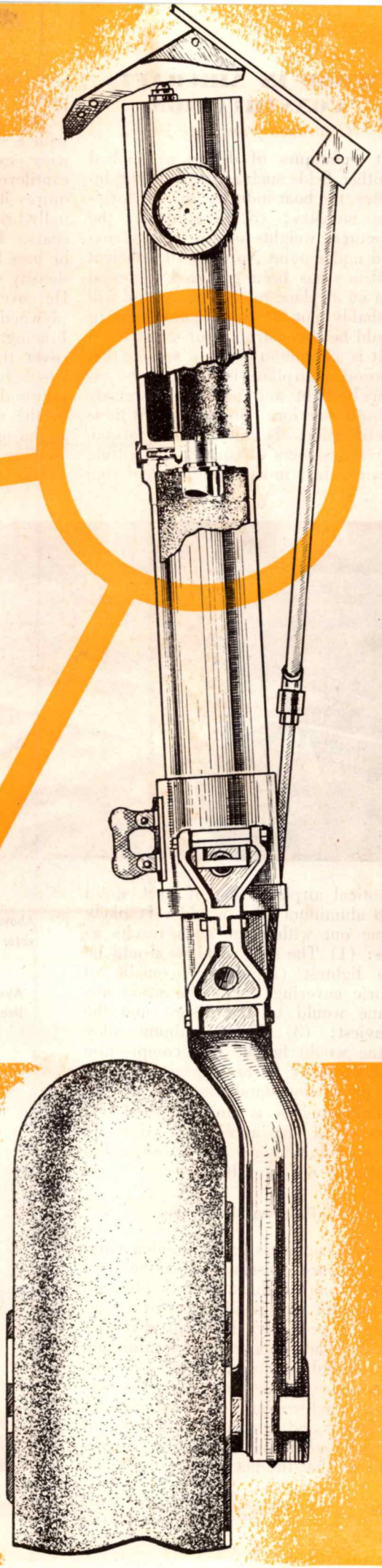


Above: Detail showing transfer valve being opened by push rod to actuate strut-shrinking mechanism as gear is partly retracted

EXTENDED



Above: As gear reaches fully-extended position, push rod disengages valve plunger and air pressure in the upper and lower chambers is equalized at about 90 psi. Pressure in lower chamber then varies according to load supported by the shock strut. Right: Over-all sketch of landing gear of P-47 "Thunderbolt"



WOOD IN AIRCRAFT CONSTRUCTION

(*Continued from page* 191)

best techniques of design as applied in other fields such as the building industry, the boat industry and the furniture industry; (3) a study of the structural weights of the planes covered under point No. 1, until sufficient evidence has been gathered to reveal that an airplane made out of wood will probably not be any lighter than it would be if constructed of metal.

It is a common error to assume that a wooden airplane is going to be extremely light and have an extremely smooth exterior. Neither one of these qualifications is apt to be realized. Three designers of equal talent sitting down today, independently, to design identical airplanes out of steel, wood and aluminum alloy would very likely come out with some such results as this: (1) The steel airplane would be the lightest (if use were made of fabric covering); (2) the wood airplane would be the fastest and the heaviest; (3) The aluminum alloy plane would be the best compromise and probably be more practical from the production standpoint.

Following is a more detailed discussion of the application of wood to specific design and construction problems on aircraft.

Designing the Wings

Some engineers design wooden wings of the pure or semi-monocoque type. They visualize thick, smooth plywood skins with individual layers of veneer laid in precisely the right direction for the loads imposed, and a minimum of internal structure. It has been the experience of most such designers that their structures have come out extremely heavy and burdened with a lot of surprise additions to the internal details so that the net result is an inefficient structure having a good many parts.

The practical designer starts out with a simple two-spar, fabric-covered wing, externally braced if possible—cantilever if the general design requires it. If the wing can be externally braced he uses solid or laminated spars. If the wing must be cantilever he uses box or *I* beam spars with high density wood for spar caps or flanges. He covers the nose of the wing with plywood and uses steel tierods for drag bracing. If steel is too scarce he may cover the rest of the wing with plywood for this purpose (putting the plywood at 45° so that it will not get in the way of the bending stresses); or he may use a wood truss for drag bracing.

His wing will probably come out about 5% heavier than a comparable aluminum alloy wing and will show no particular advantages over the latter except perhaps in the matter of lower drag and possibly easier production. It will, on the other hand, probably be much superior to the supermonocoque wing in all respects except smoothness of exterior. This result is really not discouraging when we consider how little the wood designer has to work with.

Plywood Gas Tanks

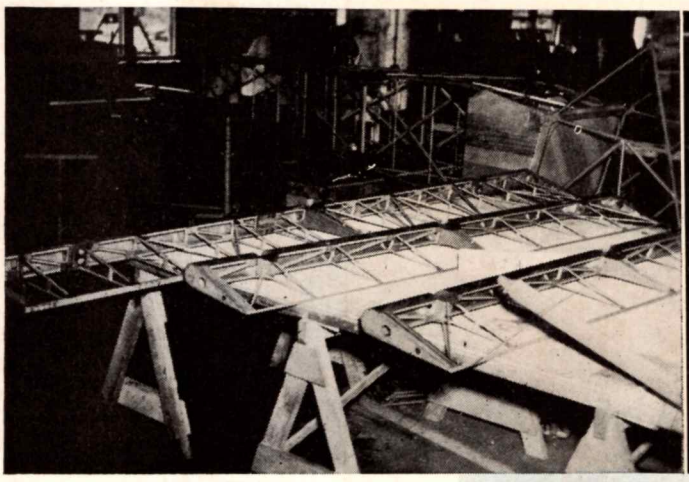
A departure from the conventional may be profitably made when it comes to gas tanks. It is possible to save a lot of aluminum by making plywood gas tanks which, when properly designed and manufactured, will serve as satisfactory tanks and add considerable strength and rigidity to the wing structure besides.

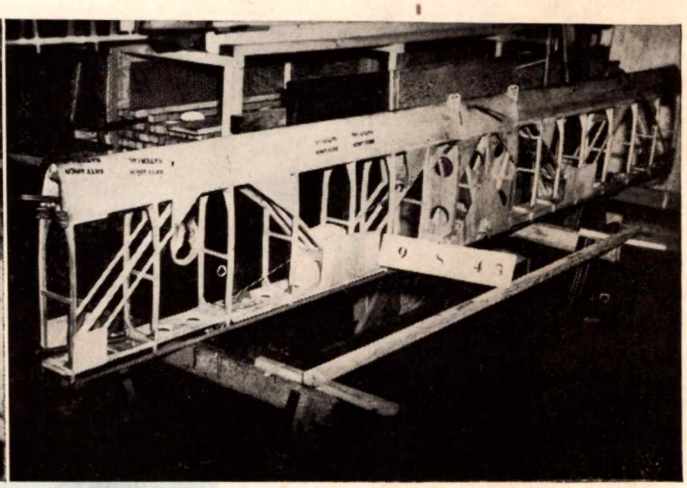
The bane of the wood wing designer's existence is the cutout. When engines are placed on the leading edge and wells for retractable landing gears are put in, or when points of concentrated load and structural space limitation are otherwise added, we get into trouble with our wood wings. All of these things can be done and have been done on wood structures; however, the development of a successful article becomes a laborious process of test, rebuild and retest, and the net result usually shows a much higher sacrifice in weight than would be necessary on a corresponding metal structure.

Reasons why wood wings come out as well as they do in weight are their high strength-weight ratio, and the fact that minimum sizes are lighter.

Next to cutouts, fittings represent the biggest bugaboo. It is usually found when the wing design is completed that the weight of metal fittings and attaching bolts makes up a surprisingly large

(*Continued on page* 288)

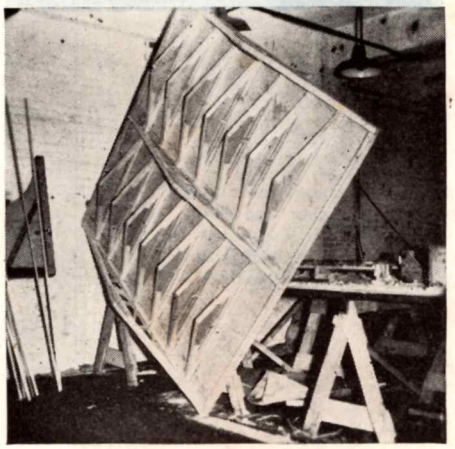


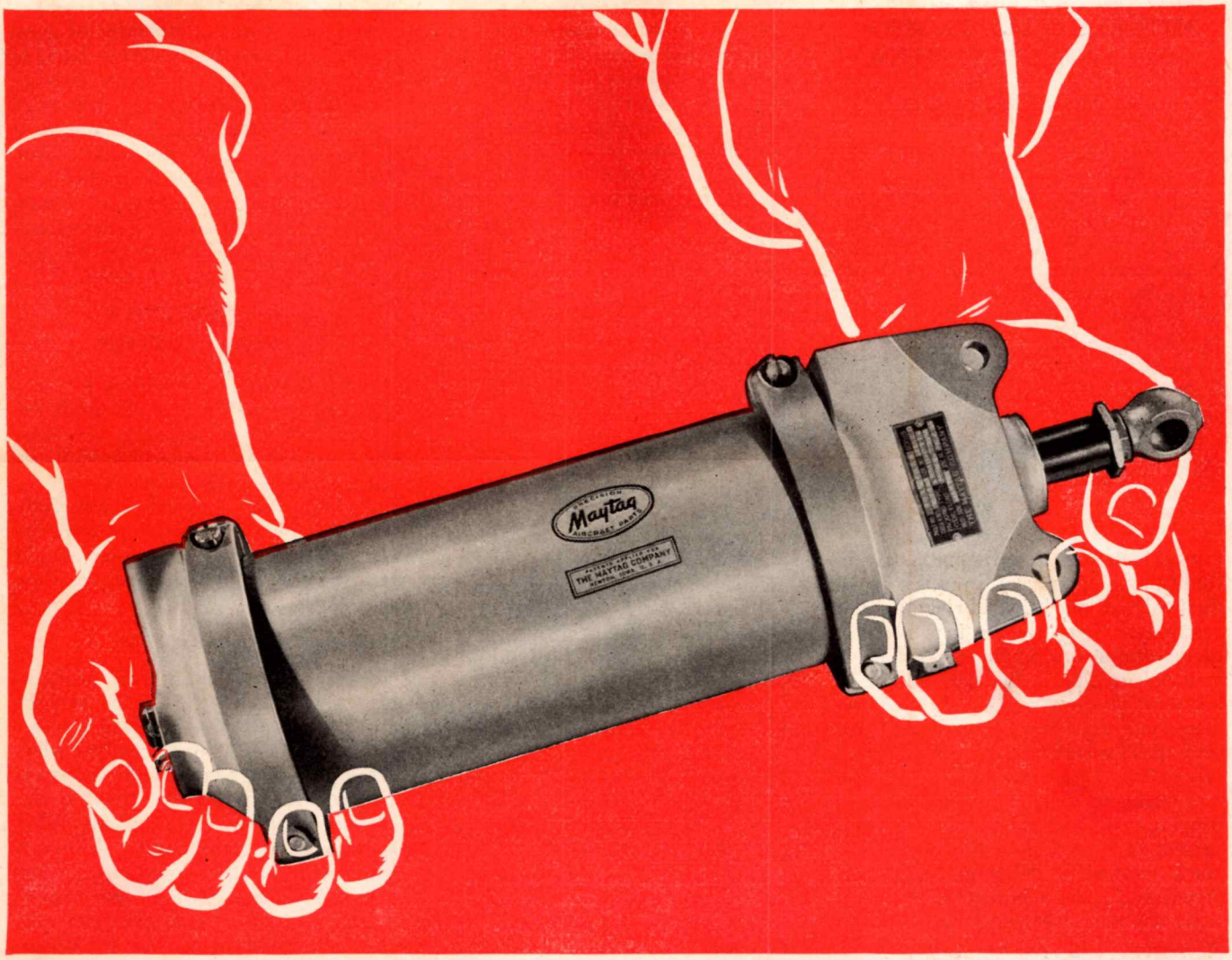


Above, left: Wood ailerons and elevator with metal trailing edges

Above, right: Cantilever stabilizer with wood truss construction

Below: Test sample floor panel for cargo aircraft





Maytag Hydraulic Cylinders Feature Rugged Simplicity

THE CYLINDER illustrated is being used today on a famous American bomber.
Its rugged simplicity is typical of Maytag hydraulics . . . a simplicity resulting in lighter weight . . . fewer parts . . . and greater dependability. Maytag hydraulic cylinders are different. They incorporate distinctly unique principles of construction.

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Maytag also produces Eclipse electric retracting units . . . aluminum alloy aircraft castings.

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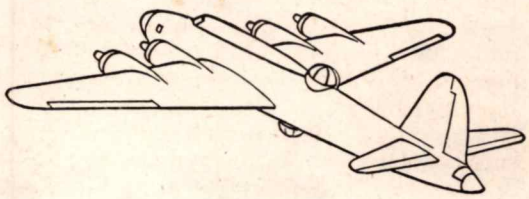


MODELS HELP IN PRODUCTION PLANNING

(*Continued from page* 228)

crease production because of lost interchangeability. Accumulated errors, moreover, result in a finished assembly that does not coincide with the original. As each tool, die, jig or fixture is being produced by a different man or group of men, it is imperative that all be furnished with identical information from which they can work, in order to have all tools and fixtures accurately formed and ready for operation at a scheduled time.

Included among the many advantages of master mahogany models, is the opportunity they afford for coordination in purchasing sheet steel, sheet aluminum and other types of materials which are usually purchased in tremendous quantities in advance of their actual need in fabrication and assembly. Since we are in a position to determine minimum sizes of sheet material or blanks, the steel mill, rolling mill, plywood mill or sheet plastic manufacturer can be furnished with the correct specifications, thus avoiding production losses through spasmodic reordering of material. By providing suppliers of flat material with the correct information in the beginning, much confusion, delay and waste of material can be eliminated.

In the past, all shapes were transferred by templates and plaster casts in a continuous series of setting-up and tearing-down operations. The element of human error in locating each individual point so many times over, was inevitably great. Since templates proved time-wasting and error-accumulating, and plaster casts were wont to expand beyond production tooling limits, methods have now been developed whereby all descriptive elements such as contours, trim lines, holes, flanges and offsets in a developed engineering master mahogany model, can be transferred to production tools by the casting of fixtures directly from the models.

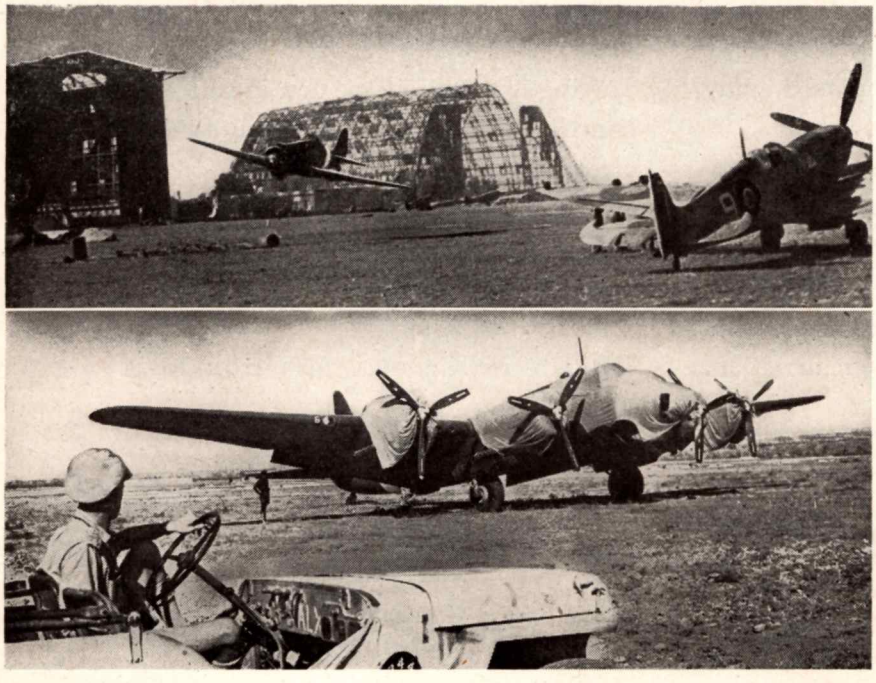
The materials used to cast these fixtures from a model are alloys which melt in Fahrenheit ranges between 158° and 255°. These alloys, composed largely of bismuth, provide the means of picking up the contour of the model against which they are poured, and anchorage provided in the fixture automatically fastens the low-melting alloy surface to the face of a mahogany or steel framework. This results in a fixture providing either male or female, inside or outside three-dimensional information on the shape.

These low-temperature alloys are the only known materials that expand slightly enough, after solidification, to make feasible the maintenance of a degree of accuracy of shape commensurate with manufacturing tolerances. The alloys can be used over and over again in a continuous process of tooling and retooling. In this procedure, many large industrial plants have found the much needed "missing link" in the accurate transfer of shapes from an original model to production tooling.

Similarly, the manufacturer of good measuring instruments checks back to a master measure of length existing at the Bureau of Standards, so that all his scales will be alike, as nearly as it is humanly possible to make them. Were this not done, it is readily seen that the resulting inaccurate instruments or tools, distributed among millions of people, would throw all constructional work out of balance.

At top: An Italian "Macchi" C-200 fighter, one of many turned over to Allies after the Armistice with Italy was signed, goes through its paces at Taranto airfield. Below: This "Piaggio" F-108 bomber, only type of four-engined bomber used by Italian Air Force, was landed at a southern Italy airfield shortly after its occupation by the RAF

British Information Services



WASHINGTON IN-FORMATION

(*Continued from page* 133)

seaboard cities to sound off about the desirability of considering the merchant marine in connection with air transportation. The contention was made that to compete successfully against foreign shipping lines after the war, our steamship companies should be given the right to operate air line services.

Trend to More Realism

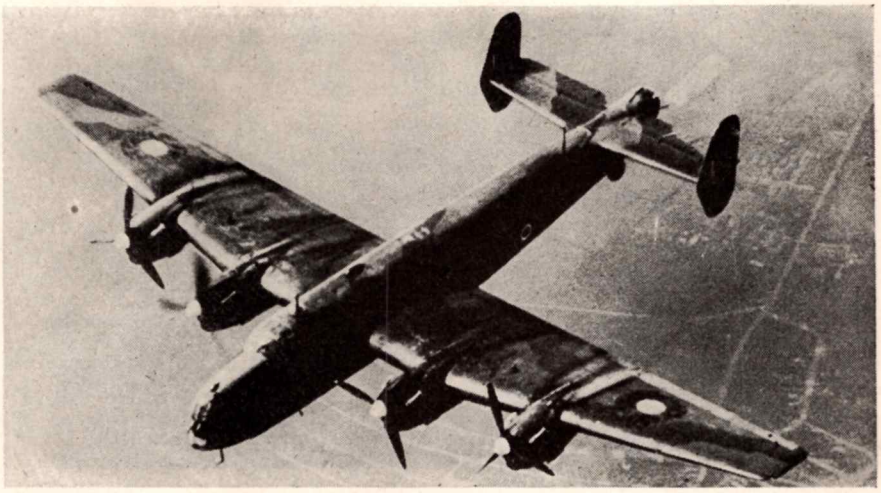
As they plot the aircraft procurement program into 1944, the various government agencies involved are beginning to take a more realistic view of the problems besetting the industry.

Illustrative of the new trend is the shifting of greater powers to WPB field offices. Corresponding shifts are being made in other programs so that the excessive amount of red tape needed to clear matters with headquarter offices in Washington can be cut down. Recently, a group of west coast aircraft officials served notice that they could not expand employment sufficiently to keep up to production schedules unless more housing was provided in their communities. Their plea received prompt attention from bureau chiefs rushed to the spot, and upward adjustments were made in the local war housing programs.

Eighty Billion Industry in 1944

At the same time, the production goal of 10,000 planes a month admittedly gives the industry a tough order to fill. In the words of Robert A. Lovett, Assistant Secretary of War for Air, "the burden which the aviation industry is thus called upon to shoulder is unprecedented in the history of industry in this country or in any other country". He has pointed out that "50 per cent of the Army's 1944 production must be aircraft and aircraft parts". Charles E. Wilson, Executive Vice-Chairman of the WPB, has translated the program in terms of dollars. Measured this way, he has computed that production next year should top the $80,000,000,000 mark, compared to an estimated $63,000,000,000 total for the present year.

One method of stimulating aircraft production that is being debated involves a proposal for two 10-hour shifts in place of the present 8-hour schedules. Establishment of these longer shifts in critical labor areas would be particularly advantageous in the opinion of T. P. Wright, Director of the Aircraft Resources Control Office. Labor consultants in the WPB are less enthusiastic. They contend that such lengthened shifts added to the transit time to and from the plants would be too much for most women employees, many of whom have a certain amount of house work to do, and would probably increase the turnover rate among men workers as well.



For instructional purposes this "Halifax" bomber was successfully flown, as shown, on only one of its four engines—the starboard inner

"Freedom of the Air" Policy

Though widely supported on Capitol Hill and in airline circles, the President's declaration for a policy of "freedom of the air" for international post-war flying has nonetheless provoked much discussion because of the questions it left unanswered. The chief executive let it be known that he and British Prime Minister Churchill have gone into the matter of developing a post-war program of world-wide freedom of the air under which all nations would participate in an interlocking system of airlines. He also made it clear that he stands for private ownership and operation of air lines to foreign countries although he feels that the Government might have to provide service over necessary but unprofitable routes.

Issue has been taken by Chairman Lea of the House Interstate Commerce Committee to the President's views concerning unprofitable lines. A stalwart champion of private enterprise, Representative Lea denies that even lines that apparently face a loss should be operated by the Government. He believes that the answer is to be found in working out some form of compensation to permit such services to be privately operated. A certain amount of dismay has also been expressed over the President's failure to be more specific as to the status of foreign bases—specifically as to whether or not some of these bases would be available to American air operators six months after the war.

B-29 Super Bomber

A guarded announcement by the OWI has revealed that the Army will soon be delivering powerful blows to the enemy with a super, long-range heavy bomber. It is understood that an unspecified number of these deadly air giants has already been delivered. The new bomber has not been designated as to type but it is presumed to be the B-29 mentioned in a late issue of *Yank*, the Army weekly. It will have a greater bomb capacity and longer range than any existing bomber. Introduction of the new bomber into the Nation's aerial arsenal will not mean tapering off of production schedules of present-day bombers, according to WPB officials. Along this line, it has been disclosed that the *Flying Fortress* has undergone changes to increase its bomb load to 10 tons, giving it a greater capacity than any bomber until the new B-29 starts operating.

In addition to the new heavy bomber, the Army has developed a new cannon-armed light bomber and a new highly versatile fighter. The light bomber which is described as being "three or four years ahead of the A-20," will be an all-purpose airplane equipped with interchangeable noses for various types of operations. Not much has been disclosed about the new fighter plane except that it is a single-engined craft designed for "greatly advanced performance."

Navy Increasing Its Air Power

Not to be outdone by the Army in forging new weapons, the Navy has disclosed that it has some plans of its own to increase the power of its aerial punches. Secretary Knox announced that three huge 45,000-ton aircraft carriers, capable of handling big bombers of a size now operating only from land bases, are to be built. They are expected to be the largest and most costly warships ever constructed. Two of the super-carriers will be laid down right away. Navy men emphasize that these new craft will be better aircraft carriers in every way, more fully capable of exploiting their advantages as "floating air bases" and are not simply intended to be used as a means of lengthening the range of bombers.

DUTCH ARE COMING BACK—FLYING

(*Continued from page* 124)

The West Indies section of KLM was founded in 1934, developed a veritable network of air routes linking all important Caribbean countries as far as Paramaribo, Surinam, Colombia and Venezuela and providing through-connections to Central America and the east and west coasts of South America.

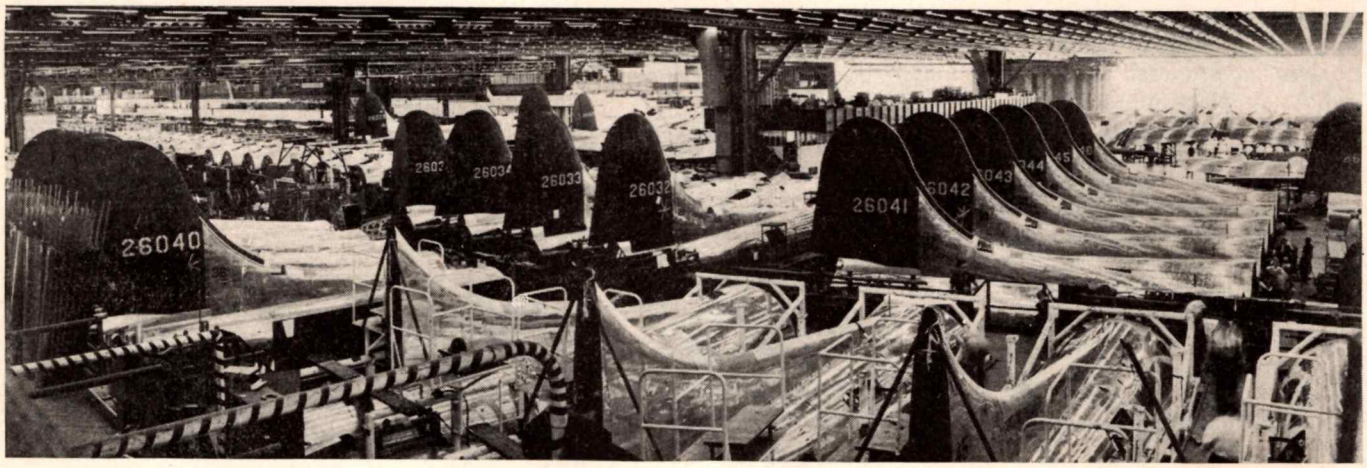
The London-Lisbon service came into existence in May, 1940, when the Nazis occupied Holland. Due to the fact that the Dutch had already established this route before the invasion, the British authorities agreed to entrust its operation to them. This service has proved of immense value to the Allies.

Airline Still Carries On

The fall of Holland and of the Dutch East Indies cut down the company's fleet from 75 to a mere dozen planes; yet the KLM still carries on regular services covering the Dutch West Indies, the Caribbean zone and the run between London and Lisbon. The four big Douglas craft on the last-mentioned service, operated by Dutch crews, have made at least 1500 wartime flights with passengers and cargo.

After the occupation of Holland by the Germans the KLM continued to link European airlines with the Netherlands Indies' capital of Batavia, through planes maintaining a regular service between Lydda, in Palestine, and Java. This route was complemented by the far-flung network of the KNILM — Royal Netherlands East Indies Line—hooking up Batavia with virtually all important points in the East Indies. The KLM and KNILM are separate companies under a common financial management.

When the war broke out KNILM



Vega Aircraft now turns out four times as many B-17's per month as were built last January. Vega employs a unique system of three short final assembly lines backed up by sub-assemblies, according to which the work is broken down into numerous small jobs

was operating an extensive air network in the Indies archipelago, spreading from North Sumatra to Dutch New Guinea. This system measured no less than 5600 miles and, in addition, services to Singapore and French Indo-China (1400 miles) were operated, while the well-known Java-Sydney Express added another 4000 miles. The KNILM air fleet of 25 aircraft consisted of Douglas and Lockheed landplanes and of seaplanes of the Sikorsky and Grumman types which covered 200,000 miles each month.

Activities Completely Changed By War

The aspect of KNILM's activities was completely changed with the Dutch declaration of war on Japan in December, 1941. Air traffic being essential for the Indies with its enormous distances, it became the airline's obvious duty to maintain its regular services to the maximum. In addition, heavy demands were made by the military authorities. In less than two months more than 100,000 miles were covered for military purposes only—generally by night and to secret destinations.

Finally, in February 1942, the officers were transferred to Australia and the service to Java was maintained from there. Night after night the pilots covered the watery stretch between Western Australia and Java, without the help of wireless or weather forecasts, fully loaded with defense material on the outward trip, and with evacuees on the voyage back. They carried General Brett, and many American pilots to safety in Australia.

When Bandung had capitulated all planes were sent to Sydney, where they immediately engaged in air transportation work for the defense of Australia. In two-and-a-half months these Dutch planes covered a distance of 400,000 miles. As it was not possible to transfer to the necessary spare parts from Java to Australia and these could not be obtained from the United States, it was decided to sell all machines to the American Army to prevent the fleet from being grounded.

Many of the Royal Dutch Airlines' pre-war personnel are today distinguishing themselves in the service of the United Nations air forces, notably as members of the celebrated "Incognito Squadron."

Officials of both KLM and KNILM —the latter in New York and the former in London, for the "duration" —are already laying plans for resumption and expansion of their networks as soon as the enemy has surrendered, in Europe as well as in Asia. One of the new links will probably be between Amsterdam and Curacao, which line was planned long ago but delayed by the war. The Amsterdam-Batavia route will be restored immediately upon cessation of hostilities. Also under consideration are trans-Atlantic and trans-Pacific aerial routes between the territories and the United States.

Meanwhile the KLM has established its first regular air connection between Curacao in the Netherlands West Indies and Miami, Florida, following the authorization early last May of the Civil Aeronautics Board.

WOOD IN AIRCRAFT CONSTRUCTION

(*Continued from page* 284)

fraction of the whole weight. If this weight could be eliminated, present-day wood wings would be lighter than the aluminum alloy wings with which they compete.

Many attempts have been made to alleviate this difficulty. Among the more successful developments are the Chrysler Cycleweld process* which permits metal fittings to be glued directly to wood; and the perforated shear plates developed by Curtiss-Wright which allow a much higher strength per bolt to be achieved where fittings are bolted to wood. Such advances as these should eventually greatly reduce the weight which is now squandered on such items.

In the design of a wood fuselage it is necessary to lean more heavily on ingenuity and less on technical information than for any other part of the airplane structure. The designer will usually take the following steps in designing his fuselage: (1) lay out the lines with proper attention to aerodynamics; (2) study the lines with regard to interior space requirements and modify them accordingly; (3) estimate the structural weight as well as possible before ascertaining anything about the details of the structure; (4) put in on the layout all of the items of equipment, controls and disposable load that can be assumed; (5) juggle the above items around until satisfied with the balance; and (6) design the structure.

The Engineer-Salesman

The engineer who is acting as a salesman for some particular material, however, usually goes through these steps in reverse order. The result is generally what might be expected—a fuselage having one or two outstandingly excellent characteristics (depending upon the nature of the material being exploited), but failing in the primary functions for which a fuselage exists, namely: (1) to carry the disposable load of the airplane efficiently; (2) to carry the loads imposed on the tail surfaces and tail wheel; (3) to provide a satisfactory compartment for the crew; and (4) to permit easy service and maintenance of the many items usually carried in a fuselage.

(*Continued on page* 290)

* An article describing this process appears on page 183 of the present issue—Ed.

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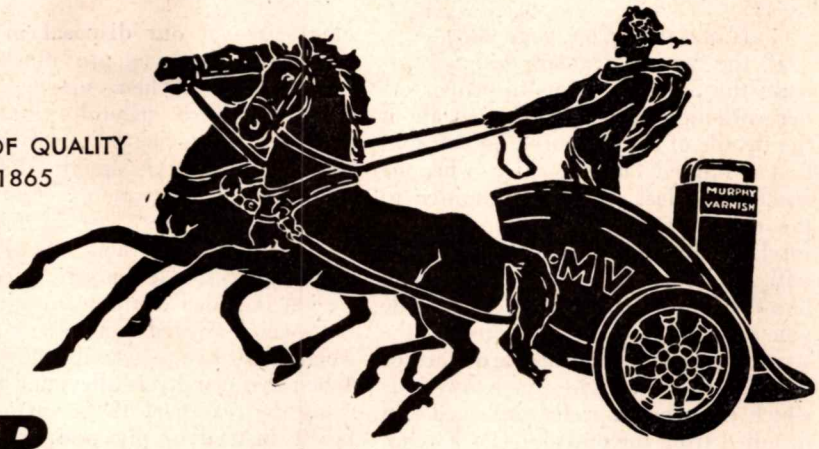

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ON PLYWOOD SINCE IT FIRST TOOK WINGS

(*Continued from page* 288)

If the wood airplane designer attacks the basic problems in proper order without worrying too much about the details of the structure, he will find that a limited latitude exists when he reaches the last step. If committed to the extensive use of plywood in the fuselage he will probably come out with a composite structure something like the following: (1) removable side panels or removable portions of the structure around the forward part of the plane where there are many items which must be inspected, serviced and installed from the outside; (2) a cabin section which is a compromise between desire and necessity, embodying a good many fittings and heavily reinforced cutouts; (3) an aft section which will probably compare favorably in both cleanness and efficiency with any other type of structure.

If the designer is not committed to the use of wood in any particular form he may find it profitable to work with a wood truss type of construction. Although such a construction does not offer any more advantage from the standpoint of streamlining than does a steel tube structure, it appears that very high structural efficiency may be achieved. At the present time few designers would venture to try this type of construction around the forward part of the fuselage, because of the well-publicized but foundationless notion that in a crack-up wood longerons are apt to inflict unnecessary injuries.

The plywood fuselage has demonstrated in service some interesting advantages: (1) excellent soundproofing characteristics without the addition of any weight; (2) excellent insulating characteristics without the addition of any weight; and (3) excellent vibration-damping characteristics.

Monocoque Has Survived

It should be realized that the monocoque structure has survived despite its relatively low structural efficiency because its use has eliminated the need for otherwise heavy additions such as streamlining and fairing. These added virtues of plywood fuselages should count heavily in favor of this material inasmuch as they represent further weight and cost savings.

In respect to control surfaces, two entirely different problems are presented by the fixed and the movable types. Fixed control surfaces can be handled in much the same manner as wings, and in general much better results can be expected as compared with metal surfaces. This is because tail surfaces are generally much less heavily loaded than wings and it is possible to take advantage of the much lighter minimum sizes at our disposal in wood.

Movable surfaces are much more troublesome. When made out of wood they are generally much less practical from the point of view of efficient structural design than any other part of the airplane. Most planes today require static or at least dynamic balance on their movable control surfaces. When the necessary weight is added to the leading edge of a plywood-covered control surface the weight sacrifice is usually quite large. When this penalty is alleviated by covering the rear part of the surface with fabric instead of plywood, the fabric tension warps the surface out of shape.

No designer, to the writer's knowledge, has satisfactorily licked this problem yet. It is easy to see why it is a difficult one. Wood is, to a considerable degree, a material having the property of "cold flow"—that is to say, when a moderate load of extremely long duration is applied to a piece of wood it takes on permanent set.

The application of fabric covering is the only circumstance in the design of an airplane which can produce a load of this nature and the result is quite inevitable—the framework yields. The only way to cope with this problem is to minimize it by careful design to such an extent that it no longer constitutes a drawback. Many other parts of airplanes can be fashioned out of wood with varying degrees of success. Surprisingly enough, it is found that nonstructural wood items such as fillets and fairings are the least satisfactory. This is because such parts are usually not complete structures and are usually subject to a good deal of handling and general abuse. In such forms and under such circumstances wood and plywood are probably the flimsiest and least satisfactory of materials, even when the weight is made to equal or exceed that of the material supplanted.

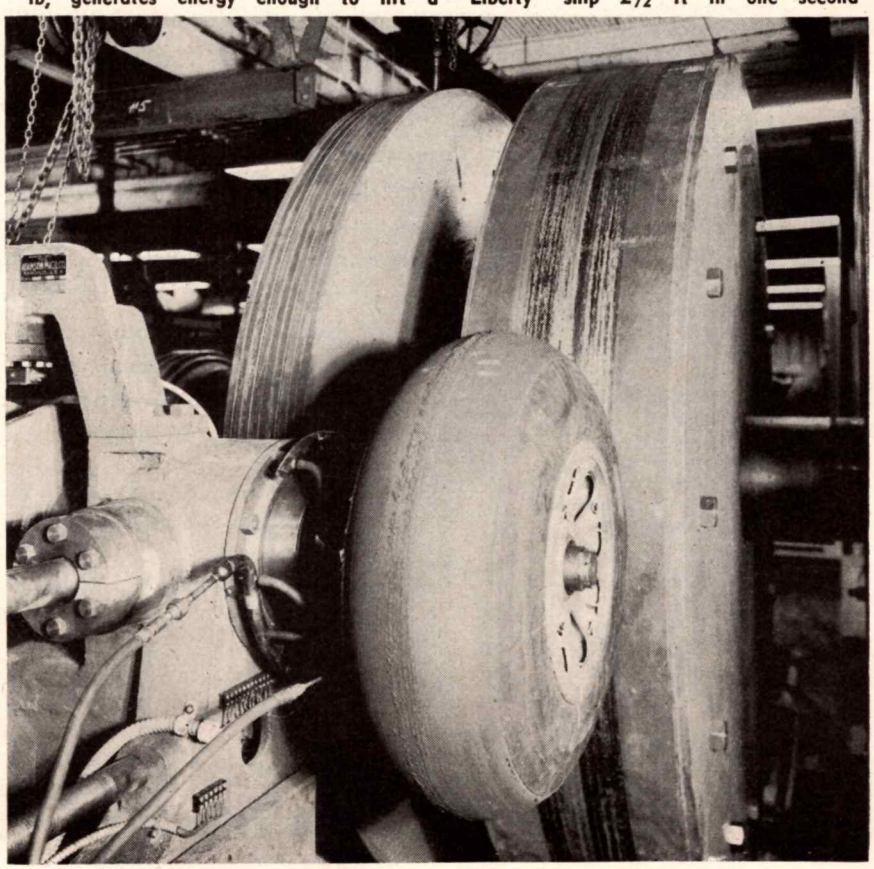
Wood Applications

Wood is much better in simple structural or semi-structural applications. Such items may include struts, floors, walkways, propellers and even wheels. Here again, as in the case of fuselages, the designer finds himself so limited by other circumstances of plane design that he must resort to many tricks to put wood to efficient use.

The development of wood propellers, for instance, has led to many experiments with, and considerable use of, so-called "improved" wood; that is, parts of the blade subject to extremely high stresses and requiring better dimensional stability than untreated wood can offer have been treated in various ways with plastics so that these properties are improved for specific uses.

(*To be continued in a forthcoming issue*)

Goodyear Tire & Rubber recently placed this giant machine in operation to test plane wheels, brakes, rims and tires. Flywheel is 10 ft in dia, installation weighs 150,000 lb, generates energy enough to lift a "Liberty" ship 2½ ft in one second



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RADIATION IN X-RAY INSPECTION

(*Continued from page* 223)

back-scatter. The lead pin-hole stop was removed and a piece of lead of 1/8 in thickness was placed over the entire film surface, after which the back lead was removed from the exposure holder. Exposure of 100 mas was made and back scatter determined from the density of the radiograph.

Both studies were made with and without the diaphragming cone, by direct exposure. Film made with use of the diaphragming cone showed less back-scatter as it did less forward scatter. This was obviously to be expected as the cone limited the area from which radiation could scatter back.

The following conclusions were drawn from these experiments:

(1) Direct exposures, especially when no diaphragming cone is used, show a considerable non-image forming fog, due to scatter from various sources. A cone or lead-stop should always be used when direct exposures are made.

(2) The Potter-Bucky diaphragm is to be preferred over direct exposures for improved radiographic quality. A diaphragm properly constructed to accommodate itself to X-ray inspection of light-alloys would be of inestimable value at this time.

(3) The action of lead-foil screens in removing secondary and off-focus radiation which is non-image forming and which decreases subject contrast in the same manner as would accidental fogging of the film, makes their use in industrial X-ray inspection of great value.

(4) Back-scatter may be practically eliminated by using a thick back lead screen of .010 in to .020 in on a lead table top of .125 in thickness.

From these studies it can be readily seen that in the X-ray inspection of even light aluminum and magnesium alloys there is present a certain percentage of scattered radiation when direct exposures are made and where the precautions outlined are disregarded. As section thickness increases, scattering increases, yet even on thin sections greatly improved results may be obtained if the above procedures are carried out in the establishing of radiographic inspection departments for aircraft.

References: L. W. Ball, "Study of Secondary Radiation in Relation to Aircraft Castings." ASTM Bul. 3-1942; H. E. Seemann, "Trends in Technique of Industrial Radiography," ASTM Bul. 3-1942.

SPEARHEAD OF POST-WAR PROSPERITY

(*Continued from page* 207)

It is certain to grow tremendously because aircraft can do a better job than could previous agencies, and the whole history of the world has proved that men will use any vehicle which will do a superior job, regardless of the initial cost.

Air travel will not, of course, drive out steamship travel. It might rule out the uneconomical, government-backed large size liners, which represented national prestige and pride rather than any economic necessity, but on the whole, increased communication and exchange of goods and passengers should increase rather than diminish the tonnage carried on surface ships.

One further word seems necessary as we face the problems and possibilities of post-war travel. In our planning we should include the lighter-than-air ship as well as the heavier-than-air plane, if we are to see to it that this country is in the best possible tactical position to achieve a leading place in the air power of the future.

The 100 mile-an-hour airship will not compete over relative short runs against the 250 mile-per-hour airplane, but there are many stretches over the world which the airship, because of its extreme range, can negotiate easily, but which the airplane can cover only with an uneconomical fuel load or by intermediate fueling stops at the expense of elapsed time—or not at all.

Lines to Africa, to India, China, Australia, could be most effectively operated by using both planes and airships—each where it can be most effective—not as competitors, but in conjunction with each other.

America is the only country which can use both types of aircraft because America is the only country which has helium gas. The Germans operated successfully with hydrogen gas up to the time the Hindenburg burned, but even if there were only one chance in a thousand of a recurrence of that fire, it would seem to effectively rule out airship commerce for any nation which did not have the non-inflammable helium.

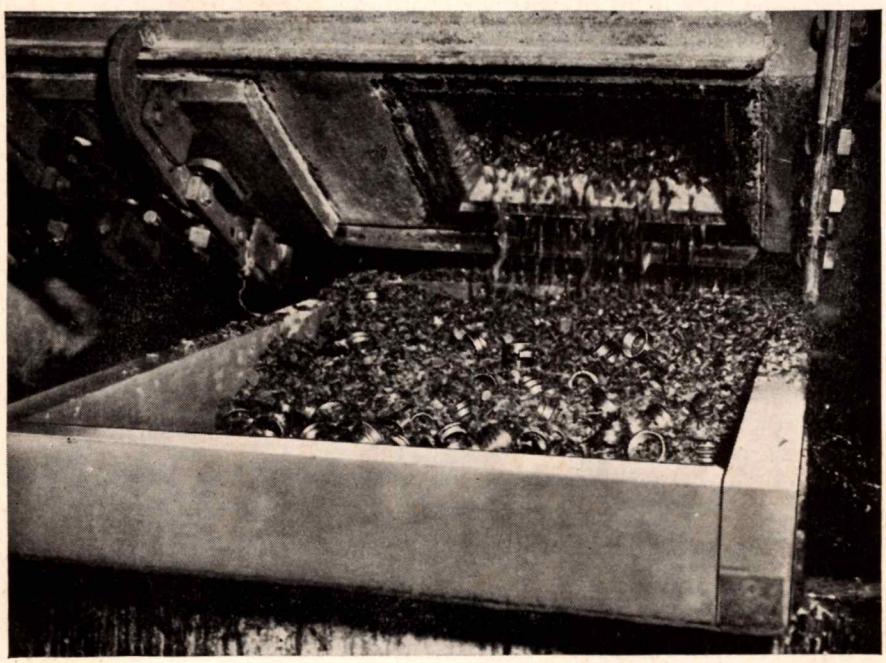
Airworthiness of Non-Rigid Ships

The smaller non-rigid airships in the present war have proved a surprising ability to go out in adverse weather which grounded other aircraft. American airships have worked out the full practicability of expeditionary masts, making unnecessary a complete airship base at every terminal. They have worked out as well the technique of picking up and of launching airplanes in flight, which technique could be used to distribute mail, cargo and passengers at intermediate stops without landing the airship. Airship travel, having comfort well ahead of even the great luxury liners—and without the elements of sea sickness or air sickness—might find a place in the over-all transport program even on the shorter hauls such as between New York and London, for passengers desiring greater speed than the steamer and more comfort than the airplane offers.

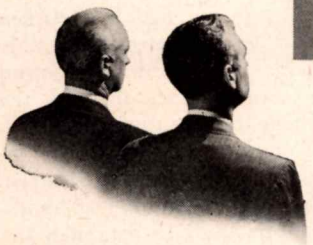
The airplane can negotiate long over-water trips only by the device of

(*Continued on page* 294)

Saving thousands of man hours, Nash-Kelvinator has adopted a process of "filing" off rough edges of very delicate parts for their P&W engines by the grinding action of small stones



Planes of Tomorrow
No. 2 Courtesy of Transcontinental & Western Air, Inc.



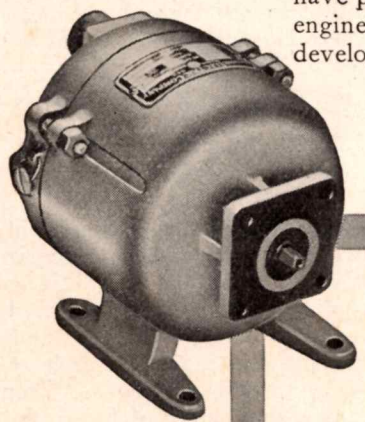
This TWA Constellation* uses lots of *SMALL ELECTRIC MOTORS*

When war was still a cloud on the horizon, TWA Airlines had Lockheed design the remarkable "Constellation," and ordered 40 of these planes, the biggest land transport plane built to date. Only recently completed, it has now become part of the Army's air transport system. When peace releases these planes for civilian use, airline passengers will gain new convenience in travel, thanks to these forward-looking engineers.

Some of the numerous small electric motors incorporated in the Army's Constellation are Bodine motors, and more and more of these motors will probably be used on the Constellation as production facilities make this possible.

When Bodine production can be again turned from military channels to applying these motors to peacetime needs, you will see more and more of them specified by manufacturers of aircraft. The wartime applications of these motors have proven their value and reliability, and through constant research, Bodine engineers keep designs up-to-date and ready for application to the newest developments in aviation.

Now garbed in army drab, the first Constellation made its maiden flight recently. As time goes by, you'll see more and more of these big planes in the news.



Bodine motors are built to meet or exceed Air Force specifications.

Bodine Has Been Supplying Industry with Quality Fractional Horsepower Motors for Over 35 Years

Bodine Electric Company, 2266 W. Ohio Street, Chicago 12, Illinois

BODINE

FRACTIONAL HORSEPOWER MOTORS FOR AIRCRAFT ACCESSORIES

(*Continued from page* 292)
intermediate stops where "stepping stones" exist, and then at the risk of delays due to weather. Such delays might cut down their time between terminals to the point at which the performance of the airship — whose great range makes intermediate stops unnecessary—would not be too far out of line, if at all.

Our own projections indicate that over selected routes airship travel can meet the airplane on a comparative cost basis. The two should not be thought of as rival vehicles, but as complementary ones, operated under a single system, each wherever it can be used by transportation experts competing with the best foreign lines that post-war world ingenuity can evolve.

U. S. Should Use Airships

Having in mind that this country has facilities for building airships, with assembly sheds available after the war; that we will have a nucleus of personnel experienced in rigid airship operation, and several thousand blimp pilots ready to complete their training in a smaller training airship (say 3,000,000 cubic-ft size, as compared to the 10,000,000 cubic-ft commercial ship now projected); and that we are the only nation on the globe which has helium—and that in vast quantities —it would seem almost criminal for us not to use airships as well as airplanes in post-war commerce.

Because of the relationship between air transport and air power, and the imperative obligation of the government to equip America with the best possible air power, it would seem to follow that it might well give whatever financial or other support may be found necessary to bring such a combined airplane-airship system into existence.

An air force without a corresponding air commerce fleet is like a navy without an adequate merchant marine or an army without motor transport, either in peacetime or war time.

FRIGID BLASTS

(*Continued from page* 196)
(fig. 4), with evaporator temperature plotted against tons refrigeration and brake hp. This graph contains considerable information relative to operation and control of the compressors.

(1) With single stage compression it is possible to operate at a maximum evaporator temperature of 46°F. Brine valves in the cooler circuit should be controlled so that with high brine temperatures from the storage tanks, brine mixing occurs to reduce the temperature of the brine going to the cooler so that the 46°F evaporator temperature be not exceeded.

(2) At an evaporator temperature of 46°F, a compressor speed reduction of 20% is required in order to prevent excessive hp on the wound rotor motor on the 2-D machine. The amount of speed reduction required to prevent excessive overload decreases as evaporator temperature falls.

(3) At 0°F, evaporator temperature, a change to compound compression is made. The evaporator temperature then drops to —4° F due to the rebalance on the brine cooler with the increased compressor capacity.

(4) To prevent motor overload, both compressors should be operated at reduced speed between —4°F and —40°F evaporator temperature, the amount of speed reduction being as shown on the curves.

(5) On centrifugal compressors a small change in speed results in a large change in horsepower. Thus motor overload can be controlled over a wide range of operating conditions, which is a point in favor of centrifugal compressors on batch cooling jobs.

A combination of figs. 3 and 4 is obtained in fig. 5, giving a composite curve showing overall equipment cooling capacity plotted against brine temperature.

It will be noted that the curve in fig. 5 is broken at four points. The break at point 2 is due to the fact that mixing of brine is used at high brine temperatures to limit the brine temperature to 69°F maximum, thus preventing excessive motor overload. The break between points 3 and 4 corresponds to change in condensing water quantity, the reduction being made to reduce pumping costs. The break between points 5 and 6 corresponds to change from simple compression to compound compression. The break between points 7 and 8 is due to change from turbulent to laminar flow in the brine cooler.

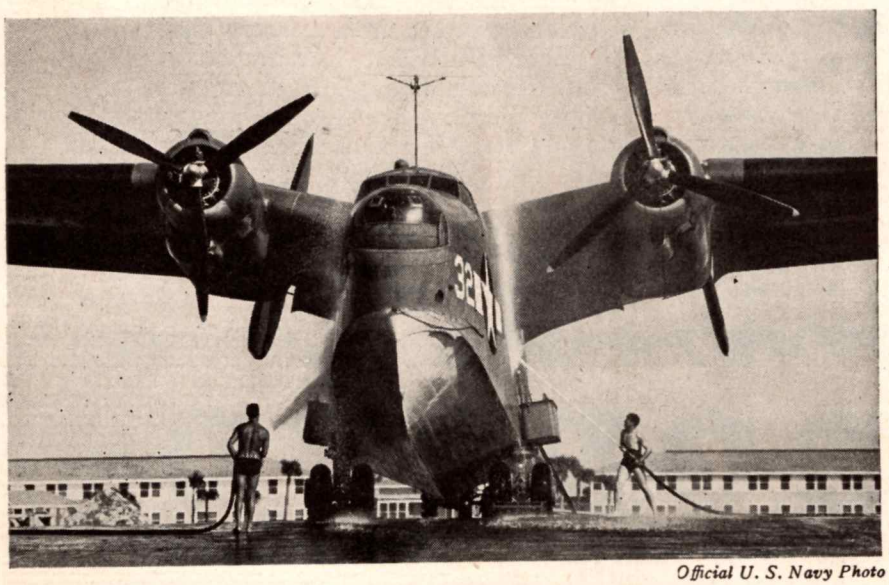
A broken line in fig. 5, between points 6 and 10 indicates a possible means of operation with compound compression taking place through the range of brine temperature involved.

Having obtained the capacity vs. brine temperature relationship curve. (fig. 5), there are a number of methods that can be used to establish the cooling time between any two brine temperatures. The brine temperatures vs. time curve is given in fig 6. The one characteristic feature of this curve is that its slope at any given brine temperature depends upon tonnage refrigeration as read from fig. 5.

The simplest method of establishing the brine temperature vs. time curve is to use the logarithmic mean tonnage process. It can be proved that for any segment on fig. 5, such as between points 2 and 3, cooling time is determined by dividing the total ton-hrs involved by the logarithmic mean tons. where logarithmic mean tons is

$$\log e \frac{\text{tons capacity at 2}}{\text{tons capacity at 3}} = \frac{\text{tons capacity at 2 — tons capacity at 3}}{}$$

This method is correct only for straight line segments of curve 5-A. It is sufficiently accurate in general application, however, if curved lines are approximated by a number of straight line segments, each segment being treated as above. From the cooling-time curve of fig. 6, the cooling time for any brine quantity between any two brine temperatures can be readily determined.



Official U. S. Navy Photo

The beaching crew of a Navy "Mariner" patrol bomber hoses down the plane to prevent corrosive action from salt water

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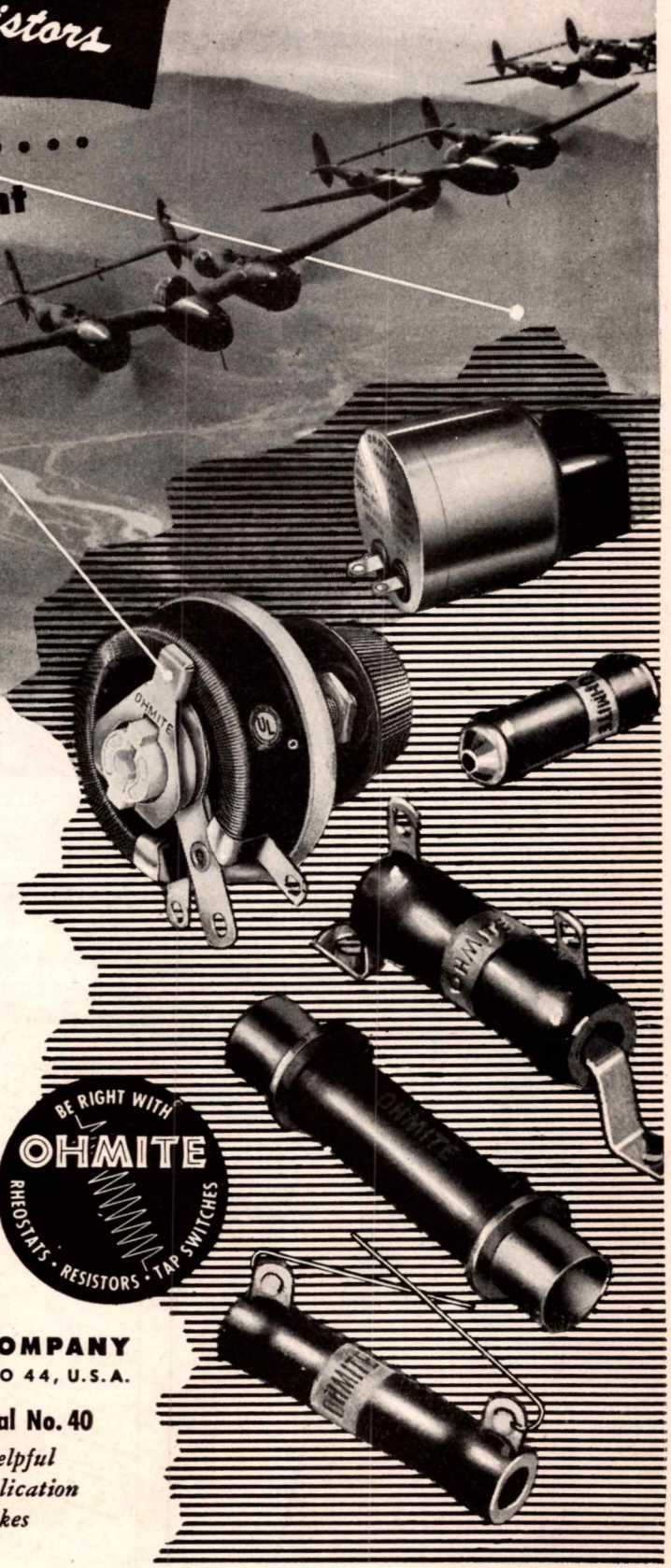
Now Fight on Every Front
in all Types of Aircraft



Years of aircraft service have proved the reliability of Ohmite Units. Designed and built to withstand shock, vibration, heat and humidity... these Rheostats and Resistors "earned their wings" through consistent performance under all types of operating conditions. They serve in instrument controls and in communications **equipment . . . from the arctic to the tropics,** from sea level to the stratosphere. They're "On Duty" on combat, bomber, training and transport planes... and in the tools of production, too.

Ohmite Rheostats provide permanently smooth, close control. Ohmite Resistors stay accurate, dissipate heat rapidly, prevent burnouts and failures.

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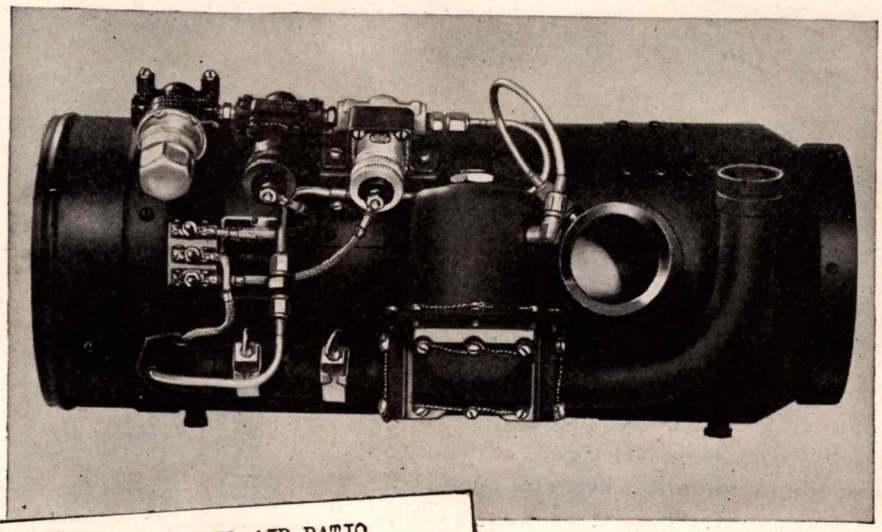
YOU SKIP at least one big headache in aircraft heating when you turn to South Wind. Because exhaustive performance tests—made possible by Stewart-Warner's *complete* engineering facilities—show you in advance the capabilities of each South Wind model. You get no "laboratory marvels"—unknown and unproved—to gamble with at your own risk and on your own time.

Typical of South Wind's "pedigreed" heaters are the two shown here. Each is completely independent of the engine. Each one, as shown, is ram-air operated. For each, a fan is available, providing continuous operation—by fan-fed air on the ground and by ram-air aloft. Switch-over from fan to ram and back is controlled automatically by ram-air pressure.

New South Wind 906-A is a 17-pound, ram-air operated unit rated at 50,000 Btu/hr. Actual test data shown below.



PERFORMANCE RUNS...CONSTANT FUEL-AIR RATIO

Type 906A
Serial 101

PERFORMANCE RUNS...CONSTANT FUEL PRESSURE WITH VARIOUS COMBUSTION-AIR PRESSURES

Type 906A
Serial 101

COLD-START TESTS

Type 906A
Serial 101

COLD START TESTS AT ALTITUDE

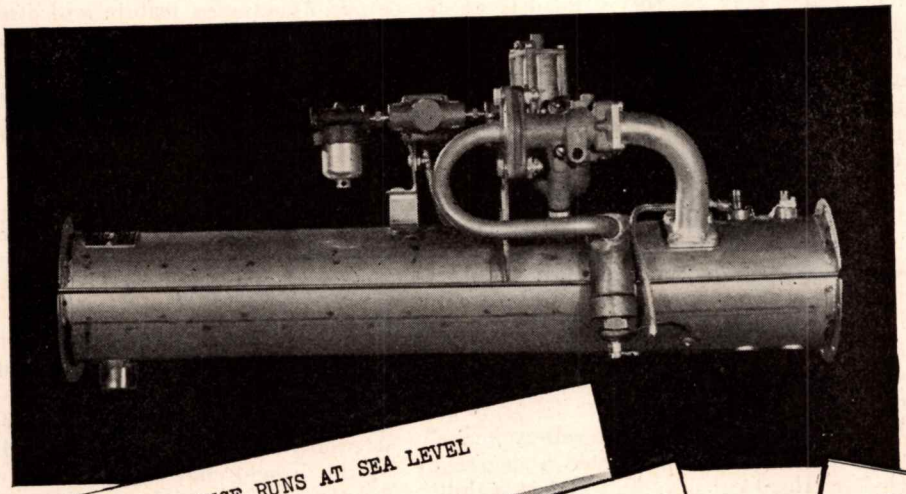
Type 906-A
Serial 101

Pressure Altitude, Ft.	Inlet Air Temp. °F	Combustion Air Pressure "H_2O ★	Fuel Rate #/Min.	Time to Start
20,000	-65	5.5	0.076	25 SEC.
25,000	-70	6.7	0.078	3 MIN 25 SEC
25,000	-68	6.7	0.078	2 " 38 "
25,000	-54	7.2	0.082	1 " 55"
25,000	-50	33.0	0.081	2 " 55"

Air Control. Voltage at Heater-24

How Fast? YOU KNOW IN ADVANCE

SOUTH WIND HEATERS!



Model 905 weighs only 7½ pounds. Continuous operation – by blower on the ground and ram-air aloft—is attained by addition of fan. Switch-over is automatic. Actual test data is shown below.

PERFORMANCE RUNS AT SEA LEVEL

Type 905
Serial X566

PERFORMANCE RUNS AT HIGH ALTITUDE

Type 905
Serial X566

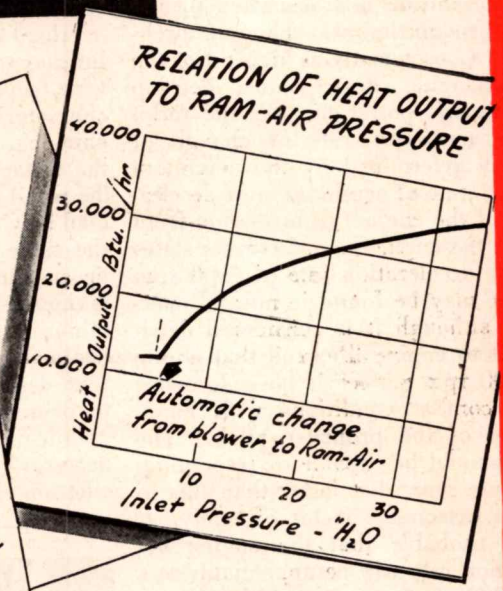
COLD-START TESTS AT ALTITUDE

COLD START TESTS

Type 905
Serial X566

Cold Room Temperature	Voltage at Heater	Inlet Pressure "H_2O	Time to Start
	24.0	2.9	4 MIN 10 SEC.
-64	24.0	6.0	2 MIN 10 SEC.
-62	23.0	2.8	NO START *
-58	24.0	2.8	30 SEC.
-40	24.0	2.8	3 MIN 10 SEC.
-40.			

* NOTE LOW VOLTAGE



Note how automatic maintenance of fuel-air ratio results in increased output as ram-air pressure increases.

Another Product of STEWART WARNER

South Wind Heaters

REG. U. S. PAT. OFF.

HEATER DIVISION, STEWART-WARNER CORPORATION, CHICAGO, ILLINOIS

West Coast Office: Stewart-Warner Aircraft Heater Engineering and Service, 1273 Westwood Blvd., West Los Angeles, California

PARALLEL OPERATION OF AIRPLANE ALTERNATORS

(*Continued from page* 174)

tained over a wide range of input speed. This development gives the a-c electric system prime movers of proven reliability and high-altitude performance.

A number of difficulties must be overcome in adapting constant-speed drives to this application. Because of the large size of the main engine in proportion to the rating of the alternator, the engine is a rock-steady source whose speed is practically unaffected by alternator loading. On the other hand the engine speed may suddenly be changed because of flight requirements, yet the alternator should not perceive this change. As a result, the drive or its governor must incorporate the load-dividing feature, and the governor must be quick in coming into action and be able to change the drive ratio at a rate faster than the engine can accelerate. In a speed converting mechanism the difference between the input and output torques appears as a torque reaction on the housing, and it appears to be unavoidable that this reaction torque is transmitted principally through the ratio-changing mechanism. Consequently at high ratios the ratio-changing device must develop considerable power to alter the ratio.

The necessary rate of change of ratio is determined by the maximum possible rate of acceleration or deceleration of the engine. Information from one of the engine manufacturers states that an acceleration rate of 3000 rpm per sec may be found in normal operation, although it is considered detrimental to engine life, and that a rate of 3500 rpm per sec is possible under some combat conditions with hand-control of the propeller pitch. The drive should be capable of responding at a rate somewhat faster than this to have a reasonable factor of safety. It seems probable that the engine deceleration rate will be appreciably less than 3000 rpm per sec, although no confirming data are known to the author.

Overrunning Clutches Needed

Because of the rigidity of the prime movers, it is essential that the drives incorporate over-running clutches to permit the alternators to remain in synchronism in spite of momentary deviations in drive ratios or failure of the drives to compensate promptly for rapid changes in engine speed. Partly for the same reason it is desirable that the drive have some internal slip, either inherent or introduced by the use of a slip coupling such as a fluid flywheel.

Unless the drive has an inherent slip which is consistently reproducible and is independent of the ratio setting, it is necessary that the governor be made load-responsive to provide the speed droop which is required for division of kw load between paralleled alternators. Methods are known for obtaining load division by controlling the relative phase position of the alternator rotors without producing a change in the steady-state speed, but they lack the simplicity and reliability of the speed-droop method. Though the governor may be the droop-determining means, it will have some delay in adjusting itself to a new load level. For this reason some inherent slip in the drive will assist in the maintenance of synchronism during sudden large load transients. Internal slip will also reduce the effect of engine and drive torque pulsations. While the governor must have a rapid response rate, it must also be well damped to obtain system stability during load and fault transients. Keeping the force-inertia quotient of the ratio-changing device high will make the damping problem easier.

Experience with the self-excited a-c system has demonstrated a degree of overload capacity and system stability inferior to that which may be expected with separate excitation. The load characteristic of the self-excited machine has a definite knee beyond which the voltage is not self-supporting, with the result that a suddenly applied heavy load may cause loss of voltage, whereas the same load gradually applied may be sustained. Synchronizing difficulty is increased and the ability to burn minor faults clear or blow limiters is distinctly reduced. Alternators of current design have integral d-c exciters to overcome these handicaps.

Low-resistance damper windings are necessary to ensure freedom from oscillation excited by driving torque pulsation or load transients. Some assistance is given in synchronizing by the full-voltage method because of the damping effect on oscillations caused by closing the circuit breaker at inexact synchronous speed and phase position. When synchronizing is performed by the synchronous motor method, i. e., bringing the incoming machine up to approximate speed with no field or with weak field and closing the breaker, low-resistance damper windings are essential and some benefit is obtained by using continuous end rings. The latter feature will also increase the ability of the alternator to pull back into step automatically under some conditions of out-of-step operation.

Cold room at Consolidated's Fort Worth plant attains temperatures as low as —100° F. Picture shows aircraft hydraulic equipment undergoing cold test

Short Circuit Ratio About Unity

It has been suggested that aircraft alternators should be designed with a short circuit ratio around unity because 60-cycle practice has shown that this gives high inherent stability which will be a benefit in parallel operation and in starting heavy motor loads. The suggestion has merit, but unfortunately it results in a heavy machine. Much of the benefit may be obtained with lighter overall weight by increasing the capacity of the exciter to supply heavy excitation when needed and by making the regulator as fast as possible. Satisfactory experience with self-excited alternators having a short circuit ratio of 0.60 discounts the necessity of accepting the higher weight of the design which has a higher ratio.

The use of an exciter brings the regulator duty within the capacity of existing designs of aircraft d-c regulators which have undergone extensive development and combat service during the past two years. What modifications are necessary can readily be made to adapt them to the requirements of the a-c system. By supplying the operating coil from a 3-phase dry-plate rectifier the regulator will respond to the average of the three average phase voltages. The fact that this is an average rather than an rms response is not expected to be objectionable with alternators whose harmonic voltage output is within the limits set by the AAF tentative specifications. The tentative specification for the voltage regulators recognizes the necessity for this average response by stating that the voltage will be checked on type test with a rectifier-type voltmeter calibrated to read rms values of sine wave voltages.

The regulator includes a network designed for use in a series-type differential reactive load equalizer circuit for causing the regulators to equalize the circulating reactive current between

(*Continued on page* 300)

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and the services
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TECO Design Service
Teco has available for distribution to architects and engineers complete data on all phases of timber design, including tables and charts on timber beams, columns, floors, connector loads, bolt loads, stresses, etc.
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TECO Research Service
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TIMBER ENGINEERING CO.
National Manufacturers of TECO Timber Connectors and Tools
WASHINGTON CHICAGO PORTLAND MINNEAPOLIS
Specify Them!

(*Continued from page* 298)
alternators operated in parallel. The network is connected to a 125/1 ratio current transformer in the *T3* lead from the alternator. Zero-power-factor-lagging current from the transformer develops across the network a voltage which is in phase and in series with the line voltage applied to the regulator coil circuit rectifier. Since this increases the voltage applied to the regulator coil, the regulator acts to decrease the alternator excitation. Conversely, the presence of zero-power-factor-leading current will cause the regulator to increase the excitation. In-phase line current produces a network voltage at a right angle to the voltage applied to the regulator and therefore does not affect the operation. Fig. 4 illustrates the differential equalizer circuit which has been selected as standard by the interested manufacturers to ensure interchangeability and this has been incorporated in the tentative specification by the AAF. With this connection, if the line currents of the respective alternators are equal in magnitude and phase angle, the transformer secondary circuit circulates through the secondaries and produces no voltage drop across any of the regulator networks.

Equalizing of Overload

If one machine should deliver more than its share of current, the secondary difference current divides proportionately in the parallel impedance paths formed by the regulator network of the overloaded machine as one branch and the other regulator networks in series as the other branch. With an excess of lagging current delivered by the first alternator, the phase angle of the network voltages in the two branches is such that the excitation of the overloaded machine is reduced and that of the others is increased, with the result that the reactive load balance is restored without affecting the voltage of the system. This lack of effect on the system voltage while correcting a reactive load unbalance is the advantage which the differential method holds over the somewhat simpler scheme, in which balance is achieved by drooping the voltage of each alternator in proportion to the lagging reactive component of current which the machine is delivering, thus producing a droop in system voltage. The differential scheme is identical in principle with the load-equalizing method which is used in present aircraft d-c systems. An improvement over the d-c circuit is the use of a normally-closed interlock on the alternator circuit breaker to short-circuit the secondary of its associated current transformer when the breaker is open, and so avoid a reaction of the idle alternator circuit upon the regulated voltage of the other loaded machines. To be effective always, this interlock should be designed with the knowledge that it must effectively short-circuit a low voltage. Proper choice of contact materials and contact pressure and the use of several contact points in parallel will avoid trouble caused by contact film and dirt.

Special anti-hunting or damping means are necessary in the a-c voltage regulator because of the additional field circuit delay which is introduced by the use of an exciter. A very effective method uses a transformer to introduce into the d-c circuit of the regulator coil a voltage proportional to the rate of change of exciter voltage or the rate of change of alternator field current. When introduced with the proper polarity this voltage causes the regulator coil to anticipate the response of the line voltage, which effect tends to damp out a tendency to hunt or overshoot.

REPRINTS OF TECHNICAL ARTICLES NOW AVAILABLE

Due to war-time paper restrictions, the print order for AERO DIGEST must necessarily be held to a minimum, hence there are few extra copies available. In fact, most issues are sold out a few days after publication.

As an added service to its readers, AERO DIGEST inaugurates with this issue a reprint plan which is designed to solve the extra copy problem for those of our readers who desire to file for future reference some or all of the technical articles, without mutilating the magazine itself.

Each of the technical articles has been made up in folder form suitable for filing, and these are available at ten cents per article, to cover the cost of handling and mailing. When ordering these reprints please make sure to write name and address plainly.

The choice of a synchronizing method is somewhat dependent on the prime movers which are used. If the system is driven solely by constant-speed auxiliary engines, a manual or semi-automatic method may be acceptable because synchronizing is performed infrequently and at a time when the flight engineer is less occupied with other duties. It may be permissible to drop all or part of the load before synchronizing. With main engine drive, on the other hand, fully automatic synchronizing is definitely desirable because the availability of electric power is dependent on engine speed conditions, which in turn are determined primarily by warm-up, ground-maneuvering and flight requirements. When the several alternators come up to speed the flight engineer may have other duties requiring his attention. With automatic synchronizing, each alternator becomes available for loading as soon as it reaches synchronous speed.

Automatic synchronizing equipment has been used in unattended sub-stations and small power stations for many years with excellent service records. For aircraft use the same principles can be applied, but many refinements may be eliminated because of the presence of supervision and the necessity of saving weight. The essential features may be stripped down to means for performing the following functions:

1. Determine when the alternator frequency has approached normal, and initiate the succeeding sequence.
2. Indicate whether the bus is dead or already energized. If it is dead, initiate circuit breaker closure; or if it is alive, initiate the synchronizing sequence as follows:
3. Act on the incoming governor to adjust the speed until the difference frequency approaches zero.
4. Close the circuit breaker when the difference frequency is less than about two cycles per sec and the alternator and bus voltages are closely in phase.
5. Advance the governor to the normal load setting.
6. Open the circuit breaker at any time when the system frequency drops below the acceptable minimum.

Human Factor Eliminated

Automatic synchronizing by this full-voltage method may be accomplished with a load on the system, because the human elements of indecision and reaction time are eliminated from the operation. Nevertheless manual controls are provided so that the flight engineer may select the units to be paralleled, or he may trip any alternator circuit breaker at any time. After a machine has been connected to the bus the flight engineer may at his leisure correct any inequality in load division or error in frequency by a manual control which acts through the speed-matching device to adjust the governor setting. Thus he has full control over the operation of the system but is relieved of the necessity for performing the somewhat critical operation of simultaneously matching speed and phase position and closing the breaker at the correct instant. With four alternators he would otherwise have to go through this cycle three times in succession shortly before the takeoff.

(*Continued on page* 304)

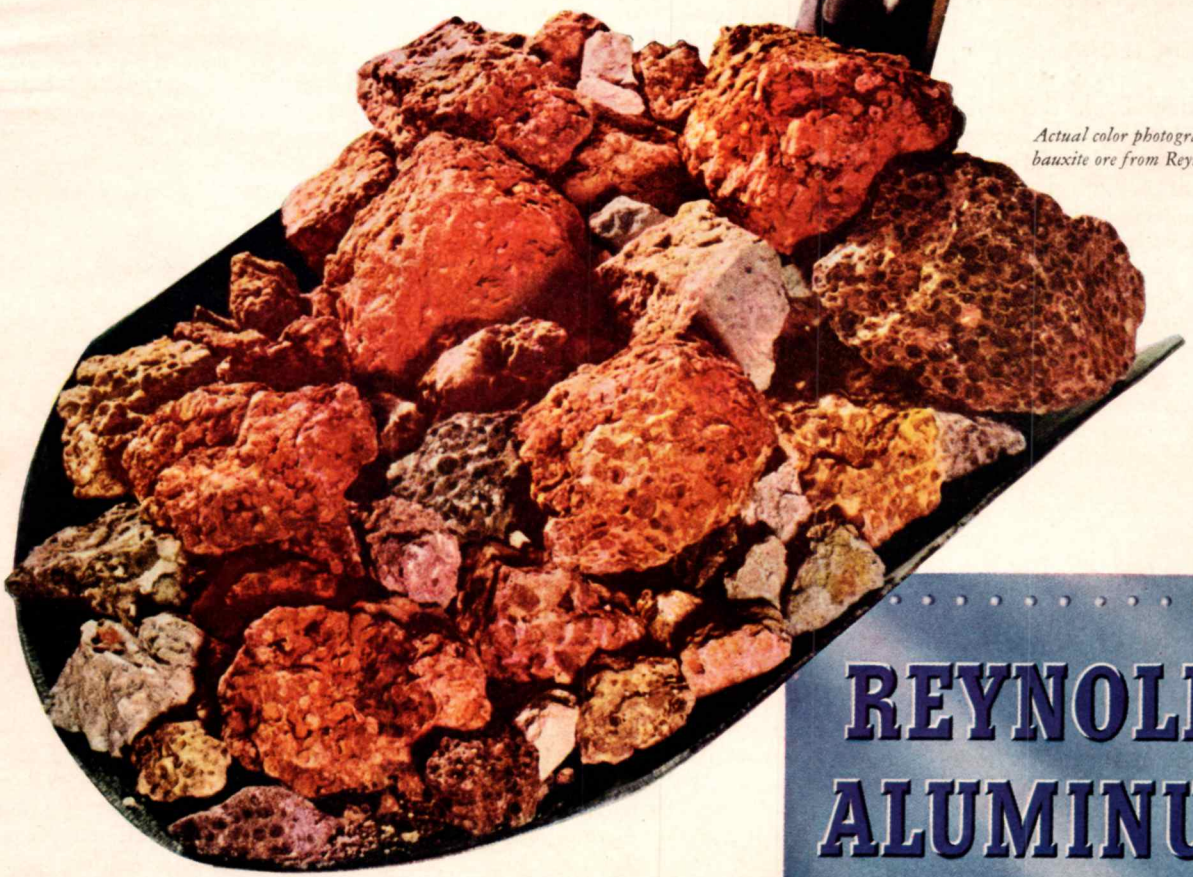
Spadework for Victory

Behind today's spectacular military success is a story of vision and daring that goes back to 1941 . . . to the first high-silica bauxite dug from Arkansas mines for Reynolds plants. For that shovelful of bright earth foretold a great new source of aluminum for America . . . a *domestic* source, immune to the threat of U-boats, unrestricted in quantity, demanding only the right kind of plant facilities to supply the largest and strongest air fleets ever dreamed of.

Reynolds built that kind of plant. Completed in the world-record time of five months and twenty-nine days, it is still the only plant in the country where bauxite comes in at one end and aluminum sheet rolls out the other. What is more, that plant was deliberately planned to process bauxite from good old American soil. This, long before Pearl Harbor . . . may aptly be called "Spadework for Victory."

But Reynolds does not rest upon past laurels. Reynolds takes the lead in prefabricating airplane parts at the aluminum source. Reynolds metallurgists look ahead for new aluminum alloys that will give even greater striking power to Allied airmadas. And Reynolds original skill, as the world's largest roller of aluminum foil, promises still further triumphs in the light-metal age of tomorrow.

The march is on . . . toward *Leadership in Aluminum.*



Actual color photograph of domestic bauxite ore from Reynolds' own mines.

REYNOLDS ALUMINUM

OUT OF THE GROUND INTO THE SKY

REYNOLDS METAL

REYNOLDS METALS COMPANY • GENERAL OFFICES • RICHMOND, VA. • 38 PLANTS IN 13 STATES

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Lumarith plastics of high impact strength "lighten the load" for aircraft designers. Today, when every possible ounce is cut from dead plane-weight in order to raise altitude ceilings and extend flying range, aviation engineers are getting important help from lightweight Lumarith. Special formulations meet and, in many cases, far exceed aeronautic specifications.

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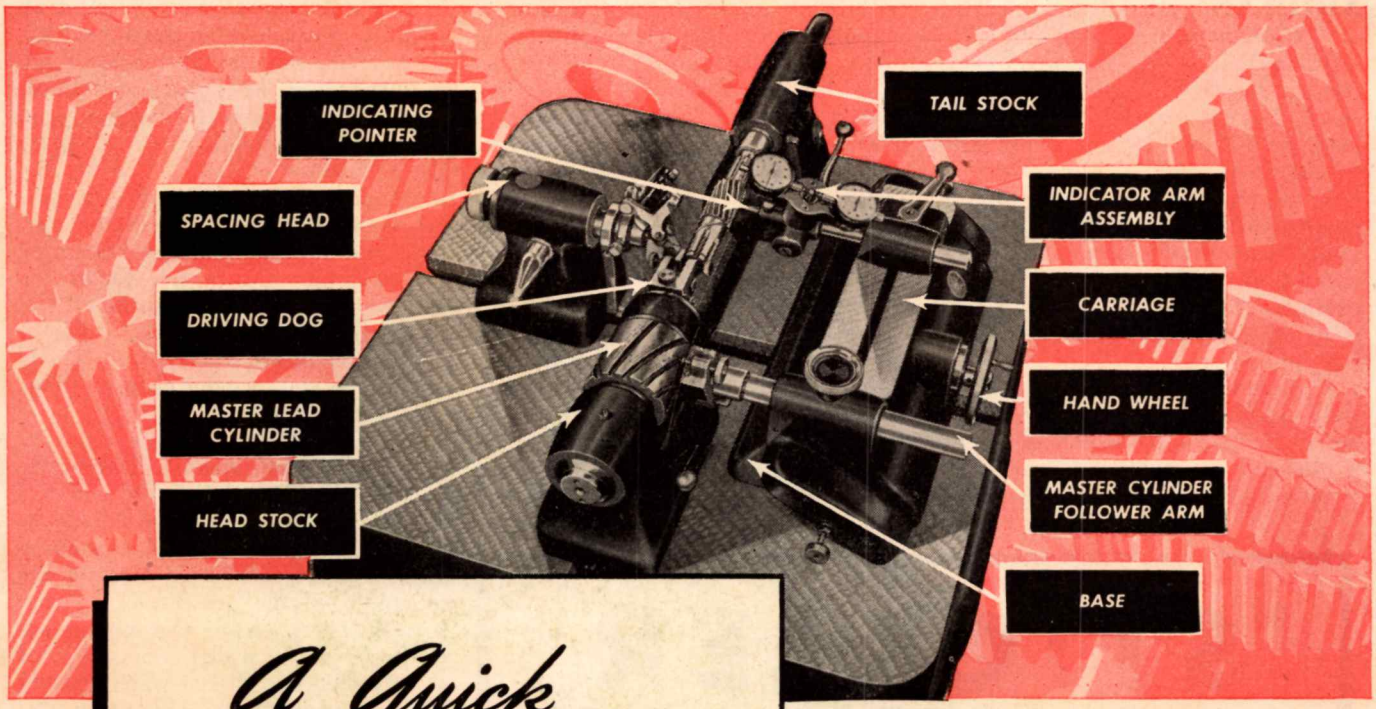

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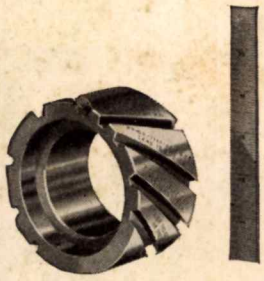

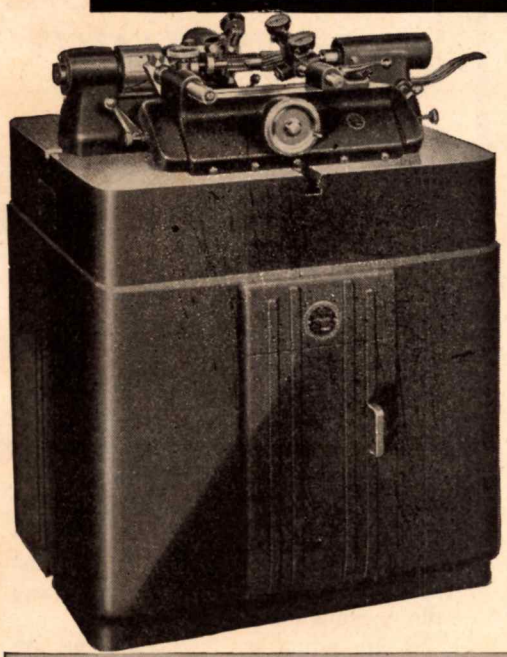

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AIRPLANE ALTERNATORS

(*Continued from page* 300)

The weight of the control equipment can be reduced by using manual instead of automatic synchronizing methods, but the saving in weight must be balanced against the increased burden on the flight engineer, the increased chance of an outage caused by faulty manual technique, and the decreased availability of the generating equipment because of failure to connect it to the bus promptly. Perhaps the least objectionable in these respects is a semi-automatic system which differs from the one described above in that the automatic speed-matching feature is replaced by a manual control. This arrangement requires the attention of the flight engineer at each synchronizing operation but largely eliminates the factor of faulty manual technique because the automatic means for determining when the breaker should be closed are retained. The weight saving in comparison with the fully-automatic system is about two lb per alternator.

Experience has demonstrated the difficulty of convincing airplane crews that kw load in an a-c system cannot be balanced between paralleled alternators by adjustment of the voltage regulators. Having had instruction and more or less extensive experience with d-c systems, they must be shown by example that the two systems are not alike in this respect. As serious misadjustment may be encountered, and as this will have an adverse effect on stability because of unequal field excitation, the process of regulator adjustment must be greatly simplified.

The fact that ammeters are not good instruments to follow when adjusting the regulators is emphasized by fig. 5, which shows how the ammeter reading varies with changing reactive current, the in-phase current remaining constant. At 0.75 power factor the ammeter responds two-thirds as fast as the reactive component, while at 0.87 power factor the response is only one-half as fast as the change in the reactive component.

A background of experience exists to guide the development of 400-cycle power systems for airplanes, and this knowledge is being used to advantage in the present program of expanding the installed capacity. To duplicate the reliability of the present d-c system, parallel operation of the alternators is required. Parallel operation of auxiliary engine driven units already has been accomplished and, given constant-speed mechanical drives with the correct characteristics, this performance can be duplicated with main-engine-driven alternators. The numerous duties of a flight engineer on a multi-engine airplane make it highly desirable to provide automatic synchronizing control to increase the availability of the power system and eliminate outages caused by man-failure. Equipment for doing this is available or is being developed.

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PERFORMANCE CALCULATIONS

(*Continued from page* 162)

is the condition of lowest power consumption, not of lowest drag, for the less the power consumed the larger the power residue available for the climb.

Imposing the condition that the right hand side of Equ. (2) becomes a minimum leads to the following relations; the items of the best climbing flight being designated by *w*.

Velocity factor for best climb:

$$(7)\quad V_w/V_e = \sqrt[4]{\frac{1}{3}} = 0.760$$

Power factor for best climb:

$$(8)\quad P_w/P_e = 2/3\sqrt[4]{3} = 0.877$$

At the velocity of best climb, the nominal induced drag is three times the nominal parasite resistance.

These equations and relations are numerically less simple than the corresponding relations for cruising. Also, the climbing flight condition is less typical for ordinary flight than the cruising condition. It is possible but

(*Continued on page* 307)

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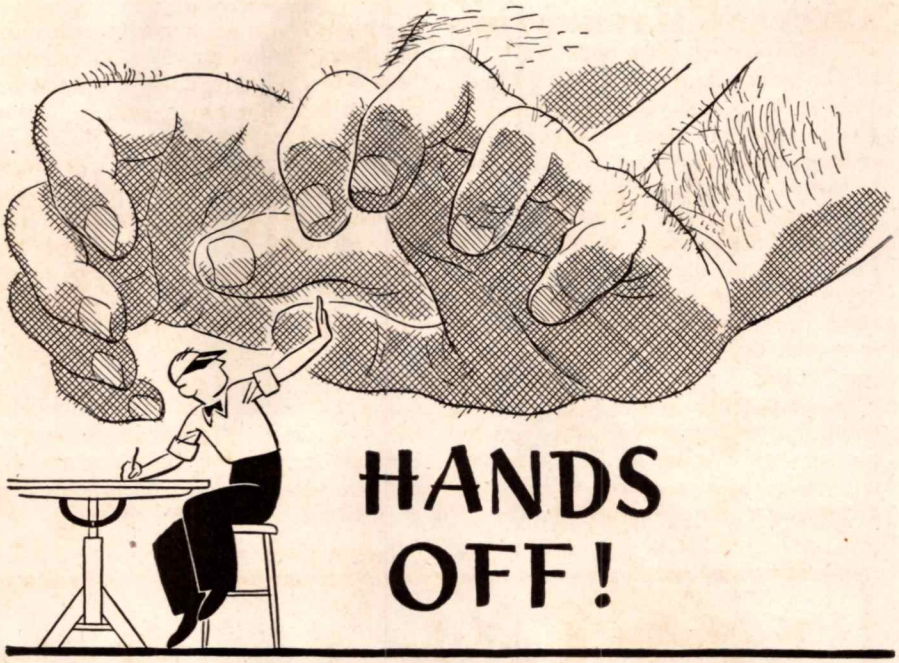

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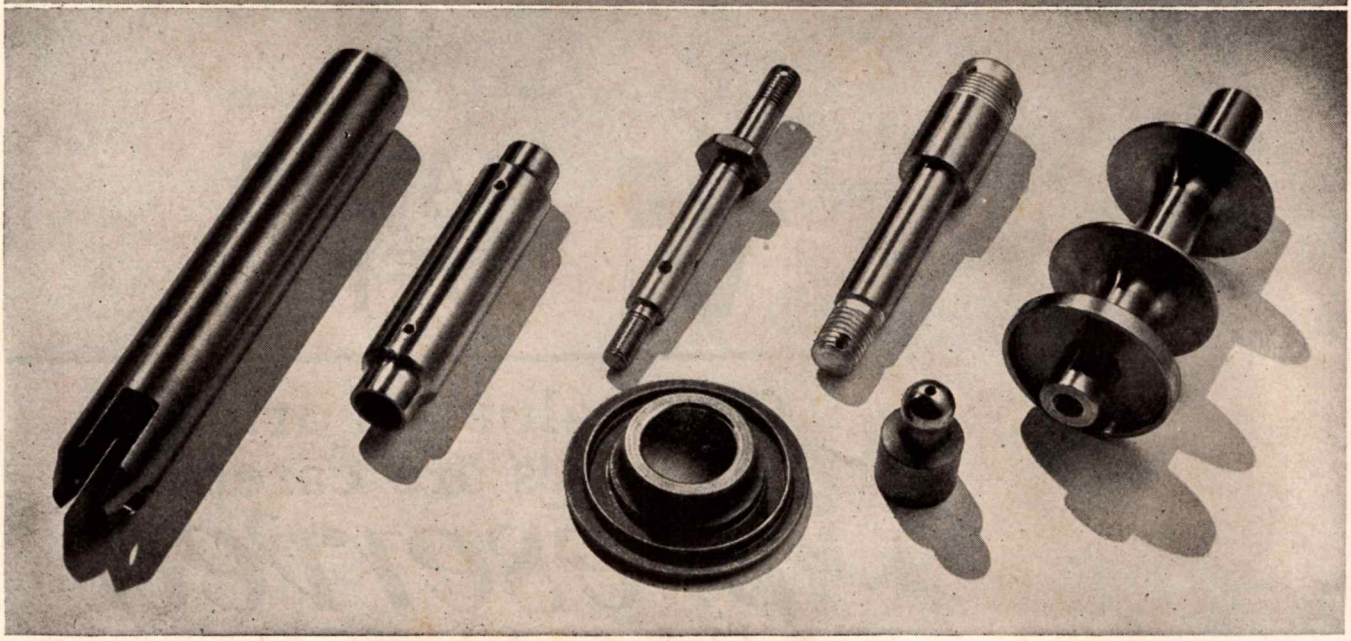

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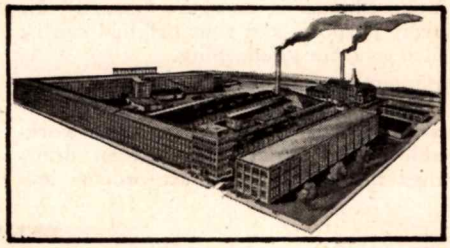

★

HARTFORD

(*Continued from page* 304)

less advisable to adopt the climbing condition instead of the cruising condition as the reference. Since all climb items are stated multiples of the corresponding cruising items, the actual difference is only formal.

The minimum power factor for level flight would become 1.0 instead of 0.877, and this would favor the use of the climbing condition as the reference condition. But this advantage is outweighed by the less convenient numerical factors that would enter. Also, the advantage is more apparent than real. An airplane having a maximum power factor of 0.877 cannot climb at all and can just fly horizontally at one definite angle of attack. Such an airplane could not take off and is not airworthy. An available power factor $P/P_C = 1.0$ is practically the minimum required.

The Reduced Basic Equation

Introducing the cruising velocity and power as reference quantities, and dividing the terms of the Equ. (2) by either the cruising parasite power or cruising induced power, which are equal, leads at last to the basic power equation in reduced or non-dimensional form, as follows:

$$(9)\quad 2\,P/P_c = (V/V_c)^3 + 1/(V/V_c)$$

This shows that the relation between the power factor and the velocity factor is universally the same for all airplanes, as far as the basic equation (1) is valid and ruling the performance.

The universal function is represented in diagram 1. The velocity factor is plotted against the power factor. A portion of the curve is duplicated with a larger scale for the power factor to show the details better. There is also plotted the curve

$$y = \sqrt[3]{2\,P/P_c}$$

As the power factor increases, the velocity factor curve approaches this cubic parabola asymptotically.

Most instantaneous performance items can be conveniently determined by the use of a diagram like the one shown. It is generally possible to determine the available thrust power for a certain flight condition. This can at least be done approximately. The performance can then be determined, and the available power be recomputed or corrected by the provisional data obtained. The computation can then be repeated. The cruising power and the cruising velocity are first computed and are then used by way of taking the aerodynamics of the airplane into consideration. Three factors enter the computation: the velocity factor, the power factor corresponding to this velocity factor and to level flight, and the maximum available power factor. Since the level flight power factor is a known and universal function of the velocity factor, this leaves only two parameters in substance, and they give the performance item in question.

The maximum level velocity at a certain altitude can be obtained from the diagram, by reading the velocity factor corresponding to the maximum power factor, and multiplying it by the cruising velocity. Thus the diagram is at the same time a plot of the maximum level velocity factor against the maximum available power factor. It is however not much more work to solve Equ. (2) for maximum level velocity.

The maximum rate of climb factor is u_m/V_C equal to

$$(10)\quad u_m/V_c = \frac{P_m}{W}\,\frac{(P_m/P_c - 0.877)}{V_c}$$

$$(10a)\quad u_m = P_m\,(P_m/P_c - 0.877)/W$$

The ceiling is reached when the rate of climb is zero.

Ceiling:

$$(11)\quad P_m/P_c = 0.877$$

The cruising power P_C increases inversely to the square root of the air density. The variation of the maximum available thrust power depends on the type of the propulsive unit. With modern engines and propellers it may be constant. With non-supercharged engines and fixed pitch propellers it declines rapidly. The intersection of the curve for the available power with the curve for 0.877 P_C gives the ceiling.

A variety of other problems can be solved using the non-dimensional performance factors. The steepest climb is for instance obtained if the available residue drag rather than the available residue power becomes a maximum. This leads to a relation between the velocity factor of steepest climb and the maximum available power factor represented in Diagram 2. There is also plotted the resulting factor for the steepness of the climb, as multiple of the flattest powerless gliding angle

$$(12)\quad w/V = k\ 2p/s$$

The requirement of minimum turning time in a horizontal turn leads to the same condition. The inverse square of the time necessary to negotiate an arc of one radian is equal to the inverse of the same factor k multiplied by the square of the time of free fall for the cruising velocity V_O,

$$T^2 = (V_c/g)^2/k$$

In either case, small flying velocities and accordingly high angles of attack are obtained. A check for stalling of the wing air flow is necessary before accepting the results.

As long as the variation of the available power factor with the altitude was more or less universal, it was possible to draw curves for the variation of the several performance items in terms of the sea level performance, using the above relations and equations. The variation of the available brake horse power with altitude is now uncertain and depends on the propeller type and on the type of supercharging, if any.

With some modern turbo-supercharged engines, the thrust power can be considered constant. This leads to a simple treatment of altitude variation questions, which remain however strictly applicable to constant thrust power only. The relations are not basic. The absolute maximum velocity is reached when the airplane has the smallest drag, that is at cruising condition, and still uses its full power. The maximum power factor is then equal to unity. This takes place at a density ratio equal to

$$(13)\quad \rho/\rho_o = 1/(P_m/P_c)_o^2$$

The maximum velocity is equal to

$$(14)\quad V_{max} = V_{co}/(P_m/P_c)_o$$

At the time when the power variation with the altitude was still fairly universal, W. Bailey Oswald used the summary performance computation method and published very complete and instructive charts for the determination of the performance of airplanes, *NACA TR 408*. His contribution reflects a very diligent and skillful application of the method, involving a careful analysis of the then available design data. While much of the diagrams are to-day of limited application only, and partly out of date, the paper is still interesting and affords excellent reading.

Oswald started with the same basic equations as are used in this article. He proceeded then to the reduction of the equations along mathematical and abstract lines. This abstraction pervades his entire paper. He did not take the step of electing a reference flight condition, the items of which would serve as a yardstick for the quantities of its kind. Starting with the same equations, he was however still bound to arrive at equivalent results. He succeeded in separating the aerodynamic airplane features from the

(*Continued on page* 310)

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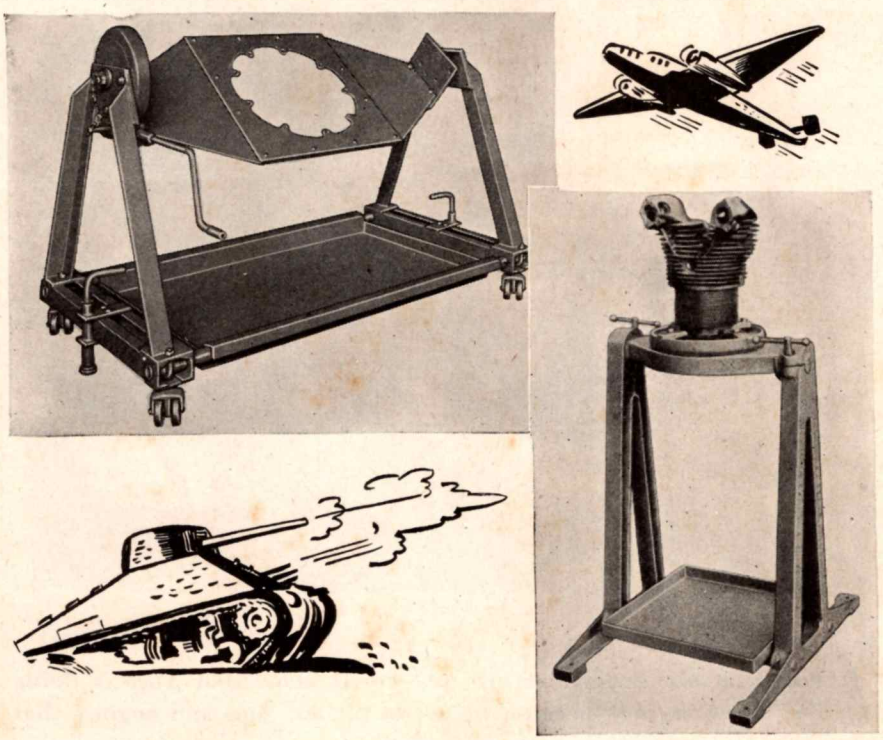
(*Continued from page* 308)
powering. For the latter he introduced a universal parameter which he denoted by the Capital Greek Lamda.

The physical significance of this parameter Lamda was quite a problem in Oswald's paper and he seems at last to have consulted von Karman and C. B. Millikan concerning it. In response Millikan wrote a contribution to Oswald's paper setting forth the best physical explanation of the parameter Lamda that he, or any other man, can give. It is necessary to resort to hypothetical, computed and unreal velocities and to the ratio of two of them for building up a mental picture of the parameter Lamda. The picture is not very striking, but there is no better one. The parameter has been arrived at along abstract lines, leaving the choice partly to chance. The parameter has not been obtained by starting out with a clear physical picture in mind. The parameter Lamda has therefore no distinct physical meaning in its very nature.

Oswald having succeeded in separating the aerodynamic cleanness of the airplane from its powering, and his parameter being related to the powering, it must stand in close relation to the power factor. Since it happens not to be this factor itself, it can only be a distorted power factor, namely a mathematical function of it. Oswald's parameter Lamda is in fact equal to twice the power factor, taken to the minus four third power. This interpretation of Oswald's parameter as a distorted power factor is fully consonant with Millikan's comments. Millikan states that the parameter indicates to some degree the speed range of the airplane, although not exactly. This is however a prominent property of the power factor. The more excess power is available above the minimum power required for climb or cruising, the larger is the maximum velocity compared with the cruising velocity, and the lower is the minimum velocity unless limited by the airflow stall. A large power factor means a large speed range.

A more modern paper on the same subject has come from W. C. Rockefeller, *NACA TR 654*. That author follows closely Oswald's paper and uses the same parameter as Oswald does.



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EDITORIAL

(*Continued from page* 142)
in terms of the industry's resources. Sales have expanded almost 20 times, while working capital, as a dollar amount, has increased only three times. As a result, the ratio of working capital to sales in the aircraft industry dropped from 30% in 1939 to 5% in 1942. This means that if the industry should lose only five cents on each dollar of sales for one year, its entire working capital would be lost—every penny of it."

Where will all this leave the aviation industry when peace comes? The figures show that it will be facing bankruptcy unless Congress comes to the rescue and changes the renegotiation law to allow adequate reserves to be put by now for post-war needs.

Obviously the government has no intention of getting tough with the aircraft makers as to their mounting tax and renegotiation debts while the war lasts—the airplanes must be produced; the workers and the raw materials suppliers must be paid; subcontractors must be kept going. Government funds will see the mounting war production through, regardless of the day of reckoning.

However, unless Congress awakens at once to the serious aspects of the situation in which the industry is engulfed, and unless Congress *does something about it* at once, all the post-war planning that goes on apace is so much time wasted—there won't be any aircraft industry under private ownership to make use of that planning. But maybe that is what Vice-president Henry Wallace would like to see happen.

INDEX

HORIZONTAL DYNAMIC BALANCING MACHINES

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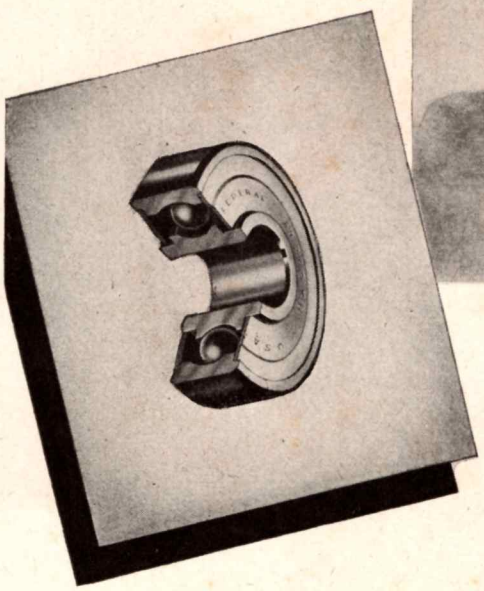

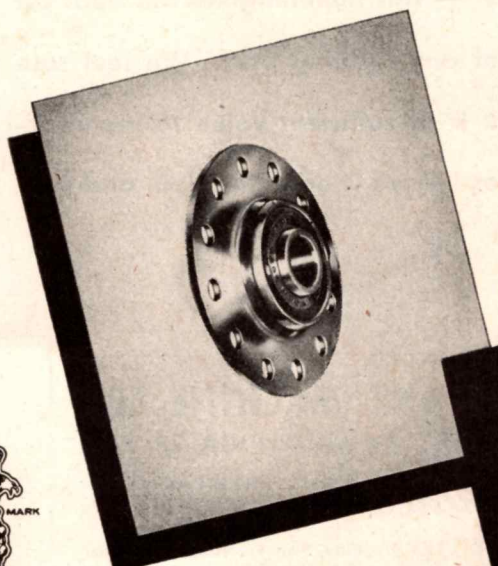

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(*Continued from page* 121)

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Slugging their way from island to island, point to point, sea and air forces continue the slow advance in the South Pacific. In a year of such progress, the Allies have taken from the Japs a strategic portion of the island of New Guinea, just off the coast of Australia. This island, however, is second only in size to Greenland, the world's largest. Port Moresby, Buna, Gona, and more recently Salamaua, Lae, and Finschaven are bloody milestones along the way, with Madang and Wewak still ahead. Another crimson trail leads to Rabaul on the adjoining island of New Britain, a trail studded with names like Guadalcanal, Woodlark, Trobriand, Munda. Close by are the historic Solomons and an enemy base on Bougainville Island was raided early in November.

Lessons learned along the way have so changed Navy thinking that the airplane carrier has superseded the battlewagon as the Navy's capital ship. Keels are about to be laid for the largest airplane carriers yet envisioned, three in all, according to a recent announcement by Secretary Frank Knox. Of 45,000 tons, each will be as large as the battleship *Iowa*, and this new class will be known as CVB. Furthermore, the CVBs will house larger airplanes than have ever before operated from the decks of aircraft carriers, larger than the B-25s that reached Tokyo from the *Hornet*. These larger aircraft are in the making—will be ready about the time the new carriers are launched —something under two years.

Huge Bombers of Future

The newest fighter aircraft, the Navy's Grumman *Hellcat* F6F, got its baptism of fire in October and its performance was hailed with enthusiasm. Carrier-based *Hellcats* knocked 30 Jap Zeros out of the air at Wake Island and strafed 31 more on the ground without the loss of a single plane. Another raid of *Hellcats* netted 21 Jap planes with the loss of two, and the ratio of the two raids was therefore 51 to 2 in favor of the *Hellcats*. A trick of the *Hellcat* is to cut speed suddenly by dropping the landing flaps—the enemy shoots ahead and it is then easy to get on his tail. Great praise is also heard for the *Corsair*. Fighter Squadron 124, for instance, fought with this type of plane for eight months; losing only three men, the squadron downed 68 Jap planes.

There still persist two schools of thought, Army vs Navy, concerning dive bombing. When the Army took up this form of bombing it had one dive bomber, borrowed from the Navy. Soon, however, it developed its own dive bombers from fighters, stopped building the Navy two-seater model which is slower. The Navy, however, still swears by its old standby, says it can dive vertically if need be, which gives it more accuracy. The Navy further claims that the Army's fighter bomber cannot dive at a steep angle, must drop its bomb at a higher altitude or chance losing its wings in the pull-out. This combines to give the bomb a looping trajectory with less accuracy. Only time and experience will prove which is correct.

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(*Continued on page* 316)

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AERO DIGEST will continue to be right. It will continue to take the lead in bringing to every interested individual the best publication that money, men and brains can put together.

AERO DIGEST will, by these permanently adopted and practically exclusive methods, continue to maintain its position as AMERICA'S PREMIER AERONAUTICAL MAGAZINE.

PRODUCTS OF AN ORGANIZATION
SPECIALIZING IN AERONAUTICAL PUBLICATIONS

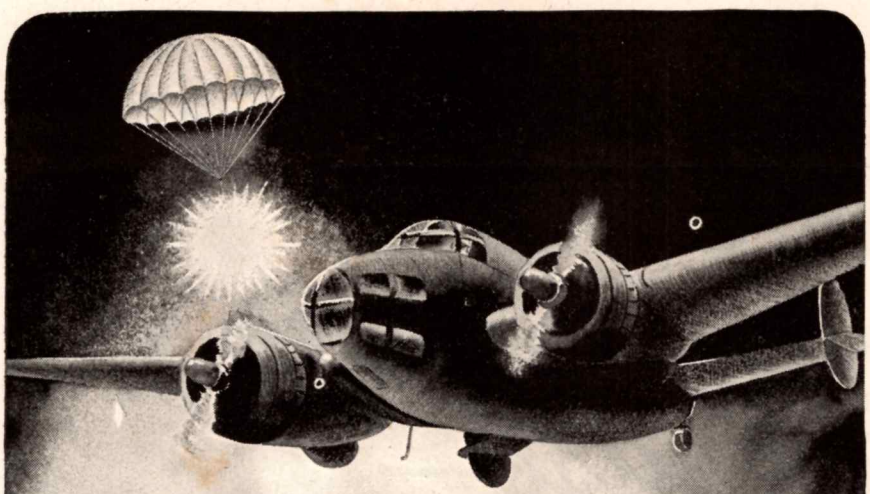
515 MADISON AVE., NEW YORK 22, N. Y.

(*Continued from page* 313)

line with tracers was once a major operation. To make it a one sided proposition American engineers invented the self-sealing leakproof tank and we were one up on the enemy for some time. However, they eventually copied some captured tanks. American ingenuity stepped forward again, this time with a new .50 cal. shell that not only blows up the fuel tank but destroys the plane by starting a fire of intense chemical heat. Blue goose is the name given these incendiaries from the blue tip that designates them from other ammunition.

The sheer weight of mass output alone might have won the war for us but that priceless ingredient flexibility in manufacture, has given our airfighting a versatility that alone spells superiority and is shortening the war immeasurably. This flexibility in production permits the lessons of today to be almost immediately incorporated in the aircraft streaming from assembly line, to fighting zones. In fact, so swiftly have these changes been made that some of our fighting aircraft, which have gained fame the world 'round for their efficiency and effectiveness, are already obsolete and are being replaced with still better models. Pessimists have harped on the fact that Hitler is moving his vital industries beyond the range of our bombers. This is no longer possible for our bombers are penetrating deeper and deeper into his territory and round-the-map bombing is already an accomplished fact.

Foreshadowing pending changes General Arnold in a recent interview on bombing was reported as saying that he was only interested in one class of fighter, the escort fighter, and that he considered the P-38 *(Lightning)* and the P-47 *(Thunderbolt)* the best types in that class; General Arnold has also expressed the opinion that the medium bomber class will soon pass out of existence but that the light bomber would survive and that the best "light bomber" in Africa was a fighter. When armies are locked in land battles, the functions of the medium bomber and the heavy bomber will tend to merge, he thought, and the heavy bomber will be the more efficient for the work required. General Arnold was presumably thinking of daylight assistance for the Army, when the bombing must be tactical.



THEY HANG UP A LIGHT TO LAND BY

PILOTS need more than "a Wing and a Prayer" to make safe landings on unlighted emergency or blacked-out fields. That's why planes carry Parachute Flares, many types of which were pioneered by INTERNATIONAL for commercial flying long before this war started.

Released from the plane, these flares remain suspended in the air long enough for the pilot to pick out his landing strip.

INTERNATIONAL is proud to fly the ARMY-NAVY "E" burgee, with one star added for continuing excellence in the production of military pyrotechnics.

ARMY E NAVY

INTERNATIONAL FLARE – SIGNAL DIV.

of THE KILGORE MFG. CO. Tipp City, Ohio

LOFTING PROBLEMS

(*Continued from page* 232)

Upon substitution of given data in equation (131), it is found that k is equal to -0.43203349.

The equation constants P, Q, R, S, and T are subsequently calculated, and the resulting equation of the required curve appears as follows:

$$y = 0.398230x + 10.9694 - \sqrt{0.265949x^2 - 9.262090x + 120.327289}$$

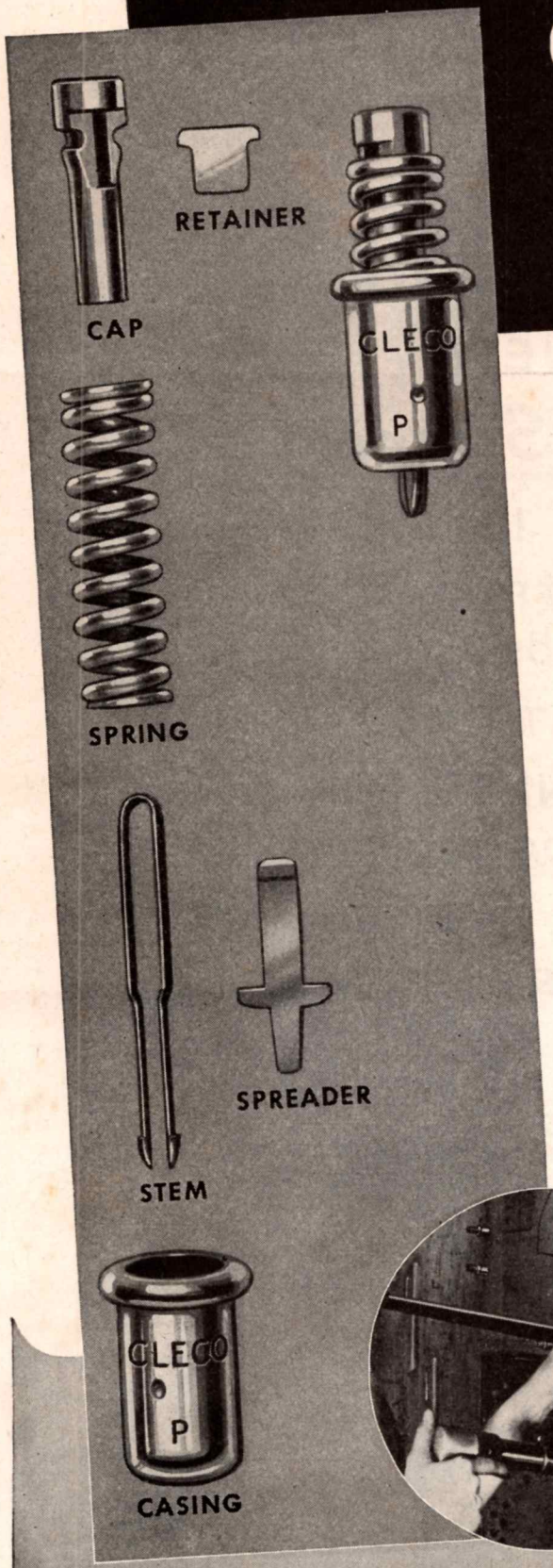
The use of one or the other method of establishing equation constants for a given conic section depends primarily upon the preference expressed in preliminary design as to the form in which it is preferred to submit basic conditions governing the curve. The calculation picture becomes somewhat simplified when slopes involving but a few decimal places are submitted as basic.

Fewer conditions are required to control the development of the desired curve when slopes are specified directly. To that extent the calculation procedures involved are further simplified.

It is obvious that the slope techniques presented in this discussion parallel in every detail the applications to the multiplicity of lofting and layout situations described in previous articles of this series. Upon the basis of the analytic derivations presented above, a complete system of formulas may be developed such as has been analyzed in previous articles related to this investigation.

NOW READY!

CLECO TYPE "P" *Triple-Safe* SHEETHOLDERS



NOW offered by the original American manufacturers of quick fasteners for airplane skin, Type "P" Cleco's have the additional advantage that the parts will not "fly" if the stem breaks. Locked at 3 points, they are *triple-safe.* As in previous types, these Cleco's are repairable and each size is colored differently for quick identification. They can be handled with any style of pliers used in the past. CLECO pliers, always handy and compact, have now been improved further, and are the best obtainable.

Cleco Type "P" sheetholders can also be furnished with longer stems and spreaders for work requiring that a greater thickness be gripped. Standard unit holds thicknesses from 0" to 3/16". A longer stem and spreader combination holds thicknesses of 3/16" to 3/8". A still longer combination holds thicknesses from 3/8" to 9/16", and so on.

Type "P" sheetholders are available in sizes 3/32", 1/8", and 5/32". Parts are either pentrated (self lubricating) or plated —thoroughly rust-proofed. With required priority, shipment is surprisingly prompt. Send for Type "P" bulletin.

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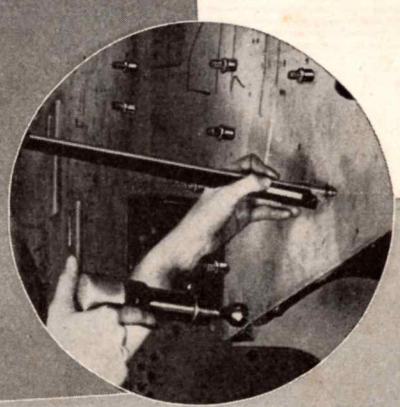

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AERO EQUIPMENT Digest

DR. ALEXANDER KLEMIN
Consulting Editor

PRE-FLIGHT GLIDER TRAINER

AeroED 2010 (Nov. 1943) . . .

Pre-flight trainer for glider students.

The glider while being towed on the ground trains students in co-ordination and mastery of controls and gives the actual feel of gliding flight. The trainer, 16½ ft long, 4 ft high, and 20 ft in span, weighs 210 lbs and has a towing speed of 10 mph. It can be used in the ordinary

high school or college football field and has the identical characteristics of a single wheel glider that is used in actual flight. It is constructed of non-strategic materials—controls, landing gear, and struts of ordinary thin wall tubing; fuselage and wings of any wood; covering of fabric. The simplicity of its construction allows it to be built in the average college or high school student workshop.

•

The illustration shows the designer of the trainer, Volmer Jensen. As recent events have shown gliding can be not without danger, and to give students pre-flight training in perfect safety has much to commend it.

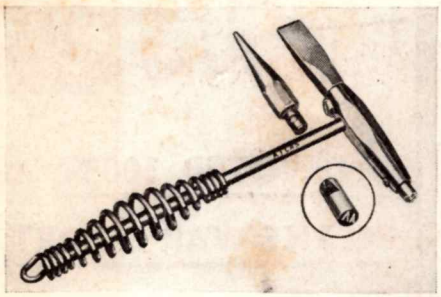
California Aero Glider Co., 1829 W. 62d St., Los Angeles, Calif.

WELDERS' MARKING HAMMER

AeroED 2011 (Nov. 1943) . . .

Combination weld marking tool and chipping hammer which indicates by a permanent mark in the steel the identity of welders and welding inspectors.

The tool contains a keyed symbol in the form of alphabetical and numerical combinations or distinctive outline symbols which are available in combinations to identify individual welders in crews up to 15,000. This large number of combinations make it also possible to include inspectors' marks in the identification system. The marking tips are interchangeable as can be seen from the above photograph. The cones or chisel



bits which are made of hardened alloy tool steel are likewise replaceable. Symbol and bit shanks are positioned and held in a snug socket fit by set screws to prevent loosening. The weight of the symbol hammer is 16 oz and its length is 10½ in. A lighter model is also manufactured. Its weight is 11 oz and its length is 10 in. Symbol hand stamps made of hardened alloy tool steel for use by inspectors are also available.

•

The tool meets a growing insistence by Army and Navy that the identity of welders and welding inspectors be indicated by a permanent mark. The claim that it is possible to identify individuals in crews running into thousands is not an idle one because of the variety of symbols or designs. The stamps eliminate the use of letters and fig-

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3 Vital Information Services in One

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ures which might be confused with other markings, and cards bear identifying numbers for each symbol.

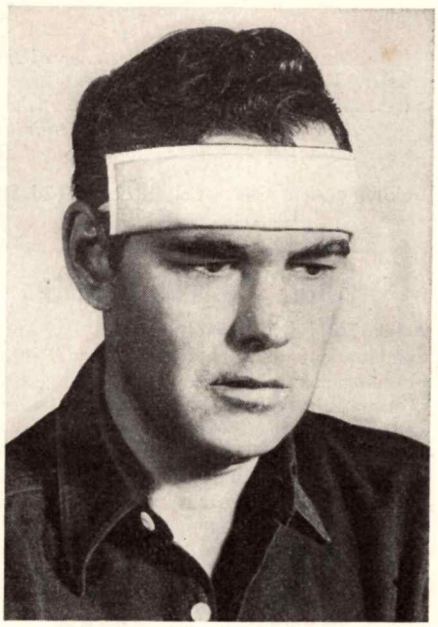
Atlas Welding Accessories Co.,
307 Boulevard Bldg., Detroit 2, Mich.

SWEAT BANDS

AeroED 2012 (Nov. 1943) . . .

Sweat bands for factory use.

The outside covering of the wide band shown in the illustration assures cool, smooth forehead contact. Vision is impaired and efficiency hindered by perspiration running into the eyes of workers, and the cellulose fibre filler within the band absorbs perspiration immediately on contact. The bands fit any size head and are so constructed that shape is maintained even when they are completely saturated. They are rugged enough for rinsing, drying and re-use, and are made entirely from non-critical material.



An accessory such as this is one of those many details which assure workers hot weather comfort and hence prevent slow down in production.

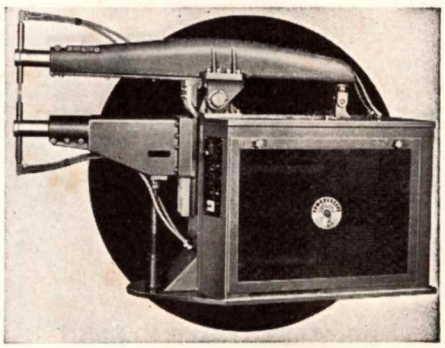
Aldine Paper Co., 373 Fourth Ave.,
New York, N. Y.

ROCKER ARM WELDER

AeroED 2013 (Nov. 1943) . . .

Rocker arm welder for condenser-discharge welding of aluminum sheet.

This welder incorporates advanced features of design and is rigid and rugged and requires few point dressings in a day's run. It is designed to handle any combination of two thicknesses of 24-ST Alclad, between 0.016 and 0.081 in at overall production rates of between 1000 and 2000 spots per hr, including point dressing time, etc. Features of the machine include adjustable throat depth (from 36 to 42 in) and a retractable upper arm to permit insertion of flanged work; this retraction being accomplished through a separate air cylinder controlled by an auxiliary foot-switch. Both upper and lower arms are of the universal type, and the lower knee with its arm is vertically adjustable over a range of 10 in. Welding arms are of 3½ in dia hard drawn copper and current-conducting castings are of high-con



ductivity bronze to reduce voltage drop to a minimum. The machine is designed for the use, if desired, of refrigerated electrodes, insulated piping, etc. Solenoid valves permit the application of a light preset air pressure to the operating cylinder to hold the points together while dressing. Provision is made on the front of the machine where it is handy to the operator, for the mounting of control panels of capacitor-discharge units. Treadle controls are of the featherweight pressure type, requiring the minimum amount of operator effort. Transformers, while rated for a maximum of 3000 v of capacitor charge, are tested to 6000 v. They are of the pancake type and are provided with a tap switch permitting selection of several turn ratios on the transformer. Standard equipment includes solenoid operated valves for controlling the air-operating mechanism, air pressure gages, air regulating valves, air line lubricator, and dual shrouded operator's treadle.

•

The Rocker Arm Welder has passed specifications tests and is already being used in the production welding of aircraft assemblies for which it is particularly well adapted.

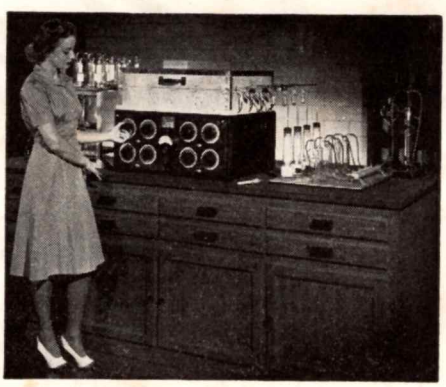
Progressive Welder Co., Detroit 12, Mich

COMBUSTION FURNACE

AeroED 2014 (Nov. 1943) . . .

Multiple unit, electrically heated combustion furnace offers several novel features.

This equipment was originally designed for the determination of carbon on cracking catalysts used for producing high



octane aviation gasoline and is modifiable to handle a wide variety of organic combustions within the temperature limit of 540 C. (1000 F.) The combustion furnace

comprises an oxygen purification system for combustion gases, oxygen pressure regulating column and electrically heated furnace 24 in long, with four combustion tubes 1 in dia x 30 in long. Heating intensity for each half of each tube is independently controlled, and the temperature of any tube can be readily observed by means of an indicating pyrometer. The new equipment also includes conventional absorption trains with calcium chloride for absorption of moisture and Ascarite for removal of carbon dioxide.

•

While the apparatus was primarily designed to step up production of high octane aviation gasoline, it has now found many other industrial and chemical applications.

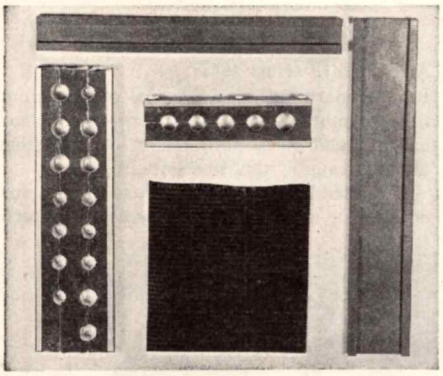
Precision Scientific Co., 1750 N. Springfield Ave., Chicago, Ill.

SYNTHETIC RUBBER COMPOUND

AeroED 2015 (Nov. 1943) . . .

Synthetic rubber compound for use in many places on the airplane.

This new compound is durable and is said to be one-third lighter than conventional synthetic rubber compounds of equal



hardness. It is designed for high resistance to compression set and to the corrosive effects of salt water, gasoline, oil, hydraulic fluid and prestone. In molded shapes it is used on many types of airplanes, as an insulator against vibration and electricity, as tank cushioning material, and as an insulating lining for line-support clips and blocks. It can be molded to specification and is also obtainable in stock sheets of various thicknesses, both plain and corrugated.

•

These excellent characteristics explain why the compound is finding many applications in aircraft. Latest approval is that by the Royal Canadian Air Force for use on cat-walks and wing-walks.

Adel Precision Products Corp., Burbank, Calif.

JOINTER

AeroED 2016 (Nov. 1943) . . .

Jointer provides extra long tables to permit accurate jointing of longer stock.

The fence on the new jointer, which is 35 in long and permits steady guiding and accurate cuts through the full length of even heavy 12 ft doors and sash, and is equipped with two-end fence locks. It is claimed that the rear fence lock makes the fence so rigid that even six times ordinary

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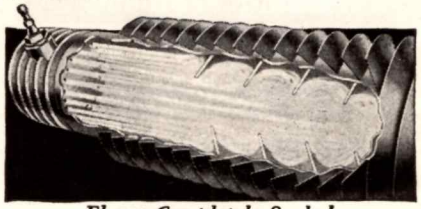
FEATURES "SEALED-IN-STEEL" FLAME

CLEVELAND, OHIO—Growing demands for simple and efficient heating for mobile service units, portable housing elements and other special problems has resulted in the setting up of a special division of Hunter and Company of this city. The sub-division will work with designers, builders, purchasers or users of special equipment for the armed forces or for essential civilian services.

Success in the varied uses to which Hunter Heaters already have been applied resulted in this broadening of interest. This has been largely due to the extreme simplicity of the Hunter "Sealed-in-Steel" burner, the fact that it will "give out heat in a big way" from any type of gasoline, from truck fuel to 100 octane.



Flame Completely Sealed

The basic unit is a completely enclosed steel tubular burner, with highly effective areas of heat radiating fins. Atomizing, ignition and combustion take place within the welded steel chamber, the only opening being an exhaust, which can be piped to an outside vent. Hunter units for both heating and ventilation include small, powerful blowers, built into the compact heater casings. Heaters designed for operation from either battery or 110 volt current.

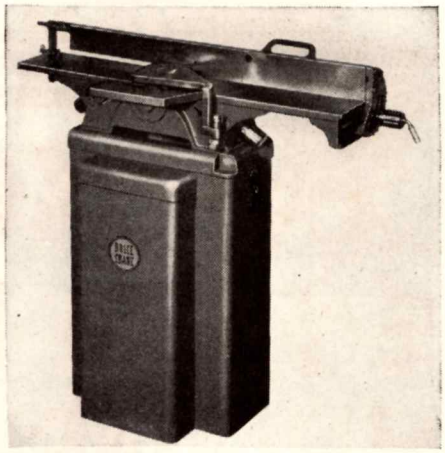
It would be impossible to list all of the uses to which the existing models can be put. Engineers with the armed forces and with companies building equipment are calling every day for applications hitherto undreamed of.

The basic principle is similar to the combustion of an automobile engine—just as simple, safe and sure. Models are made in 25-pound packages putting out 10,000 B.t.u. per hour or in larger models giving any amount of heat required. On heating problems in between or outside of the standard models, Hunter engineers stand ready to work with your engineers in fitting specific needs.

Requests for product information bulletin "HA-2" or for engineering data should be addressed to . . .

Hunter and Company, 1554 East 17th Street, Cleveland, Ohio.

(Advertisement)



feed pressure cannot spring it. The 2¾ in dia cutting head has a 3 in dia cutting arc, and the bearings and cutting head are designed to withstand speeds up to 5500 rpm. The two-way pivot guard either completely covers the cutting head or swings entirely below the table to permit rabbeting, and is never removed from the machine. Bench and floor types are offered in belted and motor drives.

•

The jointer has excellent features and with its longer fence is particularly adapted for handling exceptionally long stock.

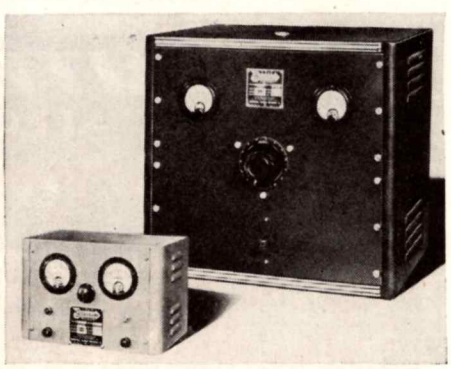
Boice-Crane Co., 501 Central Ave., Toledo, Ohio

BATTERY CHARGER LINE

AeroED 2017 (Nov. 1943) . . .

Battery chargers in a complete line of wide voltages and unlimited current range, with selenium rectifiers.

This battery charger line is divided into three general classes, as follows: 1. Low voltage type for automotive, vehicular, aircraft, high rate and radio uses, featured by ready portability, wide charging rate control, and equipped, if desired, for switching from 6 to 12 v for operation at either voltage. 2. Communications type for telephone, telegraph, signaling and alarm systems ranging from 24 to 48 v. These chargers are provided with filters to elimnate ripple and are available for floating or cyclic charging as well as with taper charge or automatic regulation. 3. The general utility types for central power



stations, machine tools, control circuits and other general requirements for 110 v and up, provide floating or taper charge, multirate charging with trickle and rate, and automatic regulated charging. The selenium rectifier accounts for the stable performance and efficiency of the new battery chargers. This ac to dc conversion unit is particularly adapted to charging batteries at either high or low rate, and provides automatic reduction of the charging current as the battery voltage increases, giving a tapered charge that protects batteries from excess temperature or undue gassing without the use of manual or automatic switching equipment. Among other features claimed for the selenium rectifier are its long life, high power factor, freedom from contacts and moving parts, elimination of replacements or maintenance, rugged construction against shock and vibration, ability to withstand momentary overloads, low back leak, negligible stand-by losses, and instantaneous operation in extreme high and low temperatures.

•

It is the selenium rectifier which is the heart of the system. These chargers can meet efficiently almost all standard needs and can be readily modified for special applications.

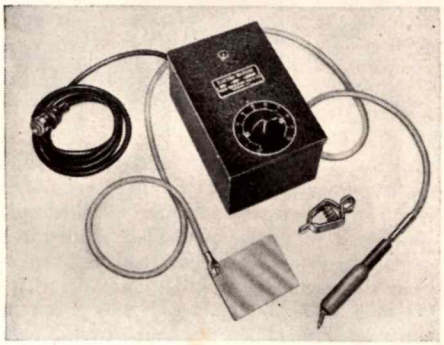
Federal Telephone & Radio Corp., E. Newark, N. J.

FREEHAND ELECTRICAL MARKER

AeroED 2018 (Nov. 1943) . . .

Line of marking equipment for placing numbers, symbols, and identifications on soft or hardened steel, alloy steels, other ferrous alloys, wrought iron, and cast iron.

Designed primarily for freehand work, this equipment can be used also as an attach-

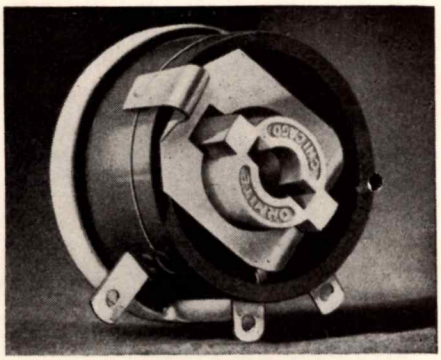


ment to a marker for pantographic reproduction. It consists of a special transformer with 10 v stages controlled by a convenient rotary switch, a hand-held marking pencil, a ground plate for use with small work, and a ground clamp for large work. The voltage selection makes it possible to obtain any desired depth of marking, from the faintest line to the heaviest arc required for penetrating through scale or dirt on castings or heat-treated parts. A pilot light signals when the current is on. The marking point is made of a special long-life heat-resisting alloy and as seen in the illustration is threaded into the holder at an angle so that it stands vertical to the work when the holder is placed in a normal writing position. The holder remains cool throughout continuous operation, thanks to heavy cork insulation and a hollow construction which permits a constant flow of air through the entire length of its Bakelite sleeve. The marker is available for alternating current, 115 or 230 v; 25, 50, or 60 cyc.

It may be noted that the device does not magnetize the work, and eliminates the necessity of stamping parts before heat-treating them and of preparing or cleaning surface before operation. It is somewhat of a safety measure that there is no acid to handle. The marker is in use by many makers of aircraft and aircraft engine parts.

H. P. Preis Engraving Machine Co.,
157 Summit St., Newark, N. J.

SLIDE WIRE RHEOSTAT



AeroED 2019 (Nov. 1943) . . .

Rheostat-potentiometer designed especially for low resistance, low wattage applications.

A length of resistance wire is stretched tightly around the outside of a cylindrical core which is bonded to a ceramic base. The wire is anchored to two terminals. Contact to the wire is made by a phosphor-bronze spring arm which is connected to a third terminal. The provision of the three terminals allows the unit to be used as a potentiometer or voltage divider. The maximum resistance which can be supplied on this unit is approximately one ohm while the minimum total resistance can be made approximately 0.1 ohm. The resistance variation is stepless since the contact arm travels along the wire from end to end. Shafts for knob control or for screw driver control can be supplied. These units can be made to suit particular applications.

•

The instrument has found several applications in the instrument field, as would be expected after study of this excellent device.

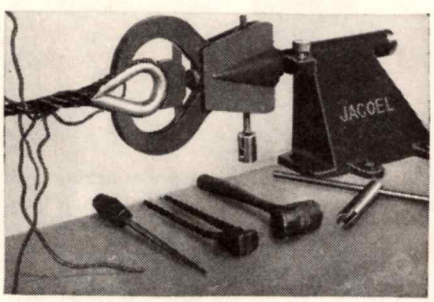
Ohmite Mfg. Co., 4835 W. Flournoy St.,
Chicago 44, Ill.

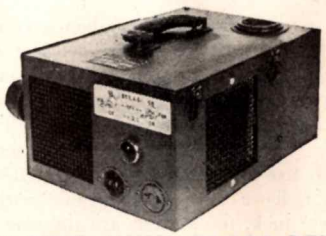
CABLE SPLICING MACHINE

AeroED 2020 (Nov. 1943) . . .

Bench type cable splicing machine to handle heavy cable up to ¾ in in diameter.

This machine operates as follows: it automatically opens the cable strands while the





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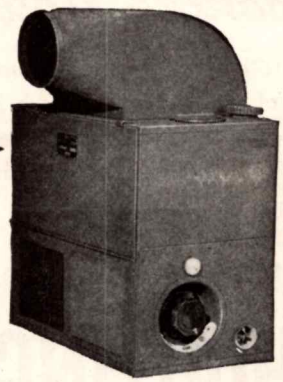

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Burn any type of gasoline—from truck fuel to 100 octane!

Uses for Hunter Universal Gasoline Heaters are too widespread and varied to list completely, and are multiplied daily by the imagination and ingenuity of men who build, buy or command equipment for the service or supply of our armed forces, or essential civilian activities.

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BULLETIN HB-3 ON REQUEST

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Ad No. 22

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TOOL & MANUFACTURING CO., Inc.
14 HOWARD STREET BUFFALO 6, N. Y.

other end is held in an ordinary bench vise. The thimble or bushing end is gripped in the adjustable jaws of the new splicing machine. By turning the swivel end of the machine, the strands of cable automatically open. The "needle" is then easily inserted without the use of a marlin spike. After inserting the loose ends of the cable with one complete tuck, the strands are tightened by a special instrument provided. This wire tightener, shaped like a fork of "T" design grips the wire with considerable leverage and pulls the strands tightly and evenly into place. This full swivel machine is provided with means to overcome torque, and will remain in any desired position. This machine has the added advantage of containing less critical metal than other similar devices.

•

Application to the splicing of aircraft cable is clearly indicated, and should certainly expedite such work both in field and factory.

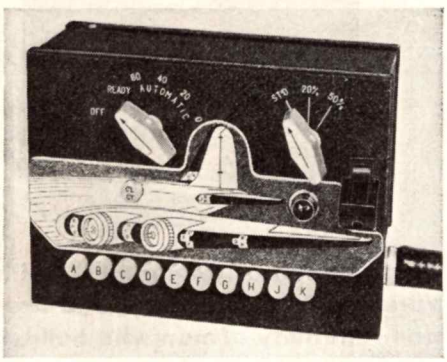
I. Jacoel Cable Splicing Co., 1880 Hertel Ave., Buffalo, N. Y.

DE-ICER SYSTEM WITH ELECTRONIC CONTROL

AeroED 2021 (Nov. 1943) . . .

Electronic control developed for use with a manifold-solenoid de-icer system on aircraft with wing spans in excess of 100 ft.

Complete ice removal can be effected by the de-icer method despite varying ice conditions, provided the accretion of ice is permitted to develop in tensile strength sufficient to overcome the adhesion between the ice and the de-icer boot on inflation. This requires the de-icer system to be controllable for both the rate of accretion and the texture of ice formation. The *Electronic De-Icer Control* accomplishes this requisite by providing a means of varying the time between de-icer operating cycles to compensate for variations in texture of ice formations. In addition, it provides a visible automatic or manual push-button remote electrical control of wing and tail de-icers (see illus).



The system consists of electronically controlled solenoid actuated distributor valves located at each de-icer boot connection; pressure type oil separator and air filter; pressure relief valve for limiting de-icer system air pressure, and an electrically controlled unloading valve for unloading the air pumps when the de-icers are not being operated. It provides a compact light weight, easily serviceable system with plumbing reduced to a minimum through the incorporation of single span-wire suction and pressure manifolds.

It is a decided advance in the art that there is available variable control to suit varying icing conditions. Complete ice removal is thereby more definitely assured. The new system is applicable both to wings and tail surfaces.

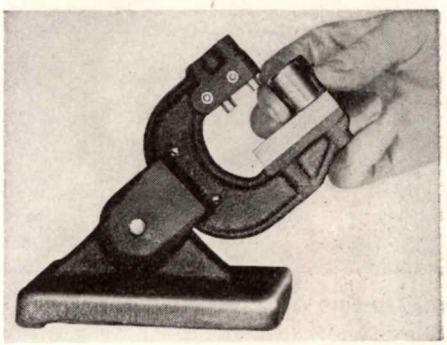
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.

SNAP GAGE

AeroED 2022 (Nov. 1943) . . .

Rapid inspection limit snap gage.

The gage known as the *#1618*, has an extended lower anvil, which facilitates inspection because the work may be readily located and leveled before moving towards the "go" and "not go" anvils. The advantage applies both to measuring diameters of round parts and to gaging external lengths. The extended anvil also facilitates gaging work in the machine.



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The extended lower anvil is clearly seen in the illustration and constitutes a thoroughly worthwhile feature.

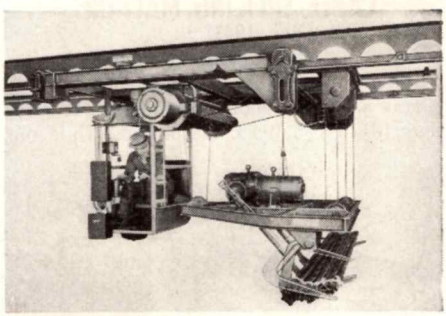
Greenfield Tap & Die Corp., Greenfield, Mass.

PIPE AND ROD CARRIER

AeroED 2023 (Nov. 1943) . . .

Motor-driven pipe and rod carrier permits the cab operator to pick up 1500 lbs of stock in 12 ft lengths from the storage room, transport and set it in racks at fabricating machines, without floor men.

The unit travels overhead eliminating the need of aisles. Another feature is the fact that materials transported need not be in balance nor is it necessary for the operator to spend time in locating the center of gravity of the load, because the pick-up fork assembly has a 3-point rope suspension from the carrier which gives it the necessary rigidity for handling loads that are far out of balance. Another factor in providing stability is the double overhead track sys-



tem on which the carrier travels, and which minimizes swing and aids in removing the danger of loads slipping and falling in transit. Rod and pipe are handled by two forks which are tilted upward when loading or downward when unloading, by a motor-driven crank. The photograph illustrates the forks in both positions. A limit switch automatically stops the forks in the upward or holding position when the fork mechanism is not in operation. The fork assembly can be raised or lowered as required. This unit has a lift of 8 ft but others can be furnished for lifts of 20 ft or more if required. The hoisting speed is 20 fpm and the carrier travel speed is 300 fpm. Similar carriers can be supplied for loads of heavier capacity and materials of other lengths.

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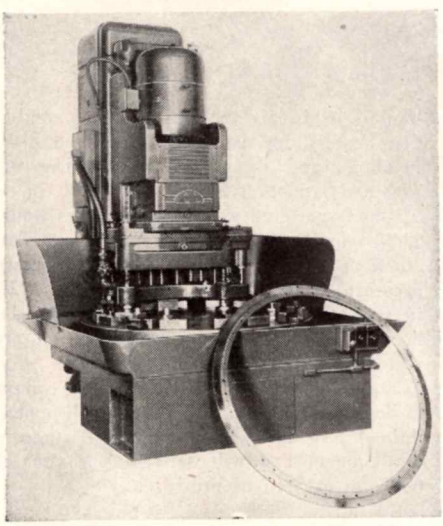
The fact that the unit travels overhead saves considerable area, while the provisions against unbalance make for safety and line swing.

The Cleveland Crane & Engineering Co., Wickliffe, Ohio

STANDARD MACHINE TOOLS FOR SPECIAL WORK



AeroED 2024 (Nov. 1943) . . .

Standard drilling, milling, and boring machine which can be adapted to work which would otherwise require the use of a special machine.

The illustration shows an example of this adaptation. The work piece is a large diameter locating ring and the operation is the drilling of 56 holes in this ring. For this operation the machine is equipped with a 14 spindle multiple head which completes the 56 holes after four indexes. The table, 60 in in diameter, is manually operated and carries the locating and clamping details. Because of the size of the table a large sub-base is used which also serves as a chip trough. This machine can be used for single spindle as well as multiple spindle work and its features include adjustable hydraulic feed with rapid advance and return under pre-set remote controls, adjustable dogs for controlling cycles and readily accessible control buttons. Both the machine and the large index table are well adapted to a wide variety of work, and since only the equipment is special, the unit

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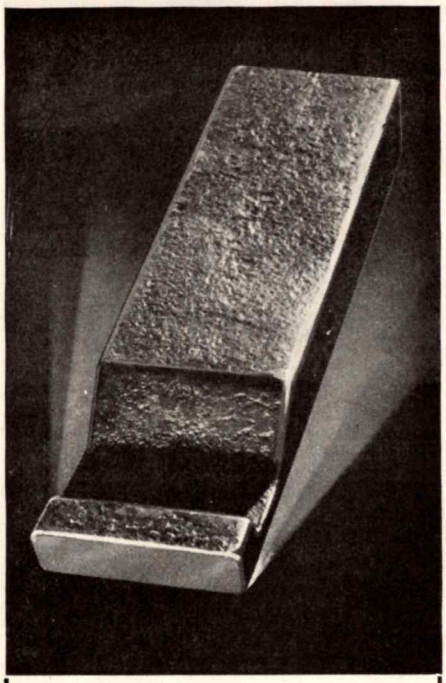

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can be readily retooled at relatively low cost. This machine is built in two sizes, the larger for drilling holes up to 5 in, the smaller for holes up to 4 in or equivalent. The ready adaptability of the machine offers wide possibilities for quick and easy conversion to a large number of uses.

•

We congratulate the makers on providing such fine adaptability to special work at a time when the machine tool industry is too harried to provide special equipment for new types of work.

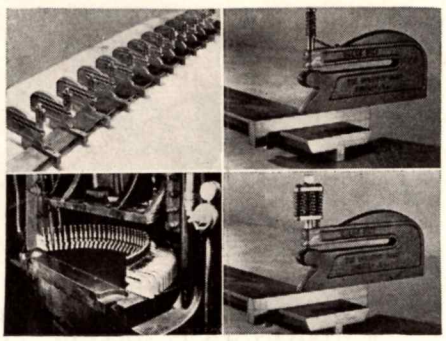
Snyder Tool & Eng'g Co., 3400 E. Lafayette, Detroit, Mich.

HOLE PUNCHING UNIT

AeroED 2025 (Nov. 1943) . . .

Hole punching unit that can be used and set up quickly on both press brakes and stamping presses to punch unlimited straight line, staggered and scattered hole punching patterns in metal sheets.

The unit is equipped with either a three spring stripping guide assembly providing ample stripping pressure for punching metal up to ⅛ thick, or a single spring stripping guide assembly for metals up to .076 thick. Both are interchangeable with the standard stripping guide assemblies of type *C* hole punching units. The units are mounted directly to a template on stamping presses, and the template is the base plate and pattern combined. On press brakes, these units are mounted to adapters which are clamped



to the press brake rail. Two styles of adapters are available; one fixed for straight line patterns and a second that is adjustable front to back for staggered and straight line hole punching. Punch and die are held in constant alignment by a holder and the units are easily removed or replaced in set-ups so they can be used and reused to eliminate costly dead storage. Nothing is attached to the press ram; the punch and die holder are a self-contained unit; the punch and die are always in perfect alignment, eliminating the usual time-consuming adjustments required to line up punches and dies of conventional set-ups; interchangeable punches and dies to punch various sizes and shapes with the same holders; die-setting time and press down time are reduced, and unlimited patterns can be set up.

•

The versatility of these units is largely due to the fact that each unit is independent and self-contained. The illustrations are quite instructive. In Fig. 1 the "AA" units are mounted on press brake rail with adapters set up to punch a straight line pattern. Fig. 2 shows them set up in stamping press on template which is a base plate and pattern combined. Fig. 3 is a single spring stripping guide assembly and Fig. 4 is a unit with three spring stripping guide assembly.

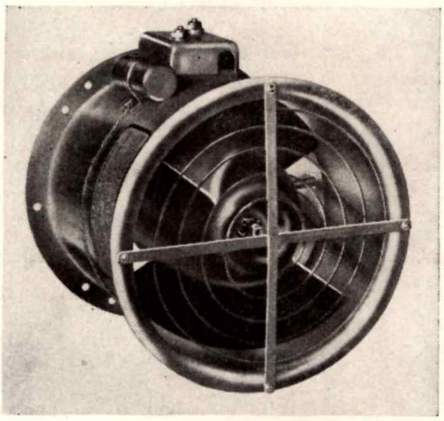
Wales-Strippit Corp., 345 Payne Ave., N. Tonawanda, N. Y.

AXIAL FLOW FAN

AeroED 2026 (Nov. 1943) . . .

Light weight high pressure axial flow fan designed to save weight and space.

This axial flow fan was originated as a single, two-blade propeller job for recircula-



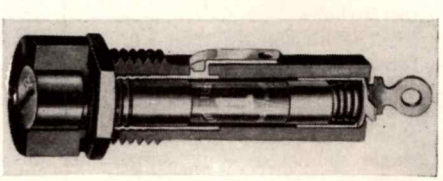
tion of cabin air through gasoline combustion heaters, for use on medium and heavy bombers, and light fast boats. The unit shown (Catalog 586-B, inside dia 6 in, wt 5.7 lbs is powered with a ⅕ hp series wound 24-28 v motor, and delivers 320 cfm standard air at sea level against 2 in water gauge pressure. It will deliver 450 cfm against 1½ in at 20,000 ft alt. Recently the power has been increased to ½ hp and a second propeller added on a double-extended shaft (Catalog 586-SCB) to add 25% more volume at double the original pressure. Still another unit of 7 in dia is now in the final stages of development and will deliver approximately 600 cfm at 5 in of pressure.

•

The illustration shows a well designed blade, with an enclosure calculated to prevent tip losses. The wire guard and crossed bars add to safety and ruggedness. It is remarkable how effective axial flow fans have become.

Dynamic Air Engineering Inc., 843 San Julian St., Los Angeles Calif.

FUSE EXTRACTOR POST TERMINALS



AeroED 2027 (Nov. 1943) . . .

Extractor post terminals connected by welding for 3 AG (1¼ in by ¼ in dia) fuses.

Anti-vibration side terminals are now mechanically connected by electrical welding to the metal shell inside the bakelite body and backed up by soft solder. The new weld-

ing process makes the terminal connection in effect one-piece, integral with the metal parts—permanent and unshakeable and proof against heat and vibration.

In actual service, as in the laboratory tests, resistance to loosening effects has been fully demonstrated. The new extractor post No. 1075 for fuses to 15 amps, is used for radios, auto-radios, amplifiers, fractional hp motors, magnets, control circuits, relays, rectifiers, plate circuits, etc. Overall length is 2½ in, length from front to panel 2⅛ in; mounting hole ½ in; maximum current, 15 amps. It is furnished for screwdriver operation meeting Underwriters' specifications, or for finger operation. Knob and body are moulded of black bakelite, impervious to temperature changes and corrosion, and are thoroughly insulated. Spacing between live parts gives adequate protection against electrical leakage.

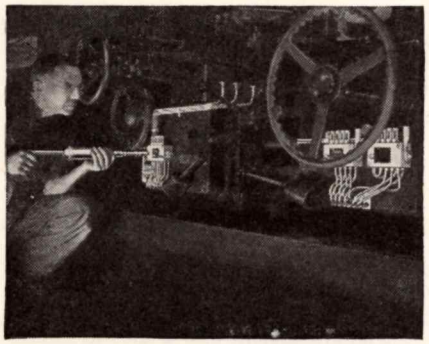
The tool-operated types have a red knob and the fuse grip permits full visual shockproof inspection of fuse. A spring-activated cup at the bottom insures positive and continuous electrical contact. The knob not only pulls the fuse but holds it and a specially designed grip prevents the fuse from dropping out. The fuse can be taken from the knob only by hand.

•

The problem of protecting such terminals against heat and vibration has long remained unsolved, and the new design seems to give excellent protection against both effects. The device is well illustrated by the photograph.

Littelfuse Inc., 4747 Ravenswood Ave., Chicago 40, Ill.

LUBRICATING SYSTEM



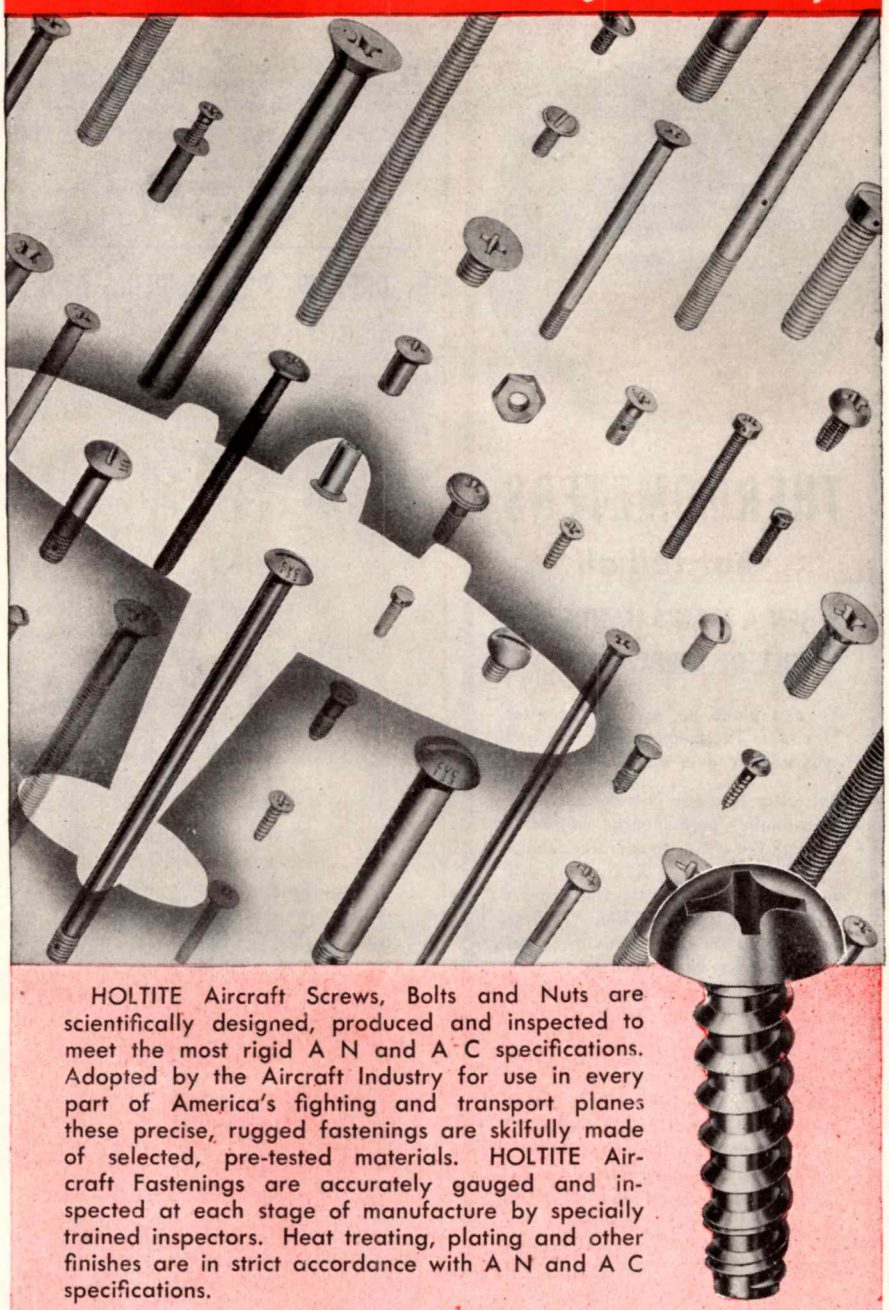
AeroED 2028 (Nov. 1943) . . .

Positive lubrication of all bearings on machine tools and similar equipment, regardless of location or condition of bearings, by an improved system.

Complete equipment consists of multiple valve blocks each serving 2 to 10 bearings, lubricant lines leading to individual points, and suitable fittings to accommodate practically any type of bearing connection. The system can be readily installed by ship maintenance crews.

Oil or grease under pressure is delivered to the distributing blocks by means of a manual or power-operated portable gun which serves as a central pump. Each measuring valve can be individually adjusted to deliver the exact amount of lubricant required by the bearings it serves and a tell-tale on each valve piston indicates the positive delivery

Precision AIRCRAFT fastenings



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HOLTITE "Thread-Forming" SHEET METAL SCREWS

When Speed Nuts are used with HOLTITE Sheet Metal Screws, the small, tapered point permits a quicker start and run-on of nut. The smooth threads with faster lead reduce nut-turning time and provide a much tighter lock to resist vibration.

Cutting their own threads in metal or plastics as they are driven in, these production-boosting screws eliminate time-consuming tapping operations and effect a stronger, tighter fastening as each thread stays tight in the perfect mating thread it has cut in the material. Available with slotted head or HOLTITE Recessed Head.

CONTINENTAL SCREW CO. New Bedford, Mass., U.S.A.
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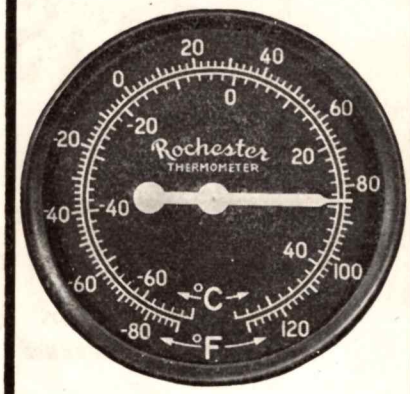

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Our Air Force pilots have confidence in the Rochester-made G.F.E. instruments that go with them into a battle-filled sky. That same confidence can be yours—send us your gauging requirements, the operating conditions you must meet. Rochester engineers can answer them.

Rochester Manufacturing Co.
40 Rockwood St. Rochester, N. Y.

ROCHESTER *Instruments*
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of lubricant to each bearing. With blocks mounted at accessible points on the machine the operator lubricates all bearings with complete safety while the equipment is in full operation.

•

Experience indicates that the "Multival" system, as it is called, reduces labor and waste of lubricant, and provides excellent lubrication.

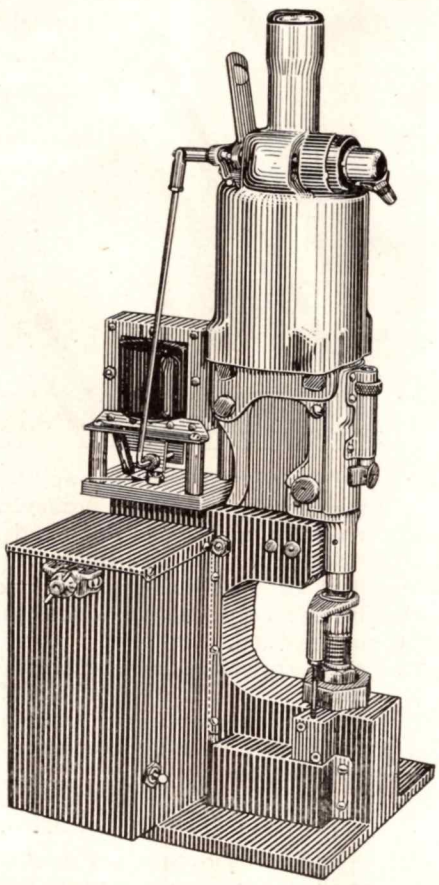
Farval Corp., 3249 E. 80th St., Cleveland, Ohio

PRESSURE PAD DIMPLING TOOL

AeroED 2029 (Nov. 1943) . . .

A tool containing a pressure pad which keeps the material clamped tight during the dimpling operation and thereby eliminates any stretching of material.

The tool consists of metal cylinder called a peen over which is placed a spring and a metal pressure pad. The latter is held



into position on the peen by means of a dog point screw. The end of the peen projects through the pressure pad and over this, the hole to be dimpled is set. An anvil, the mating piece of the peen, then descends over the peen and holds the metal firmly in contact with the pressure pad while the dimple is made. The unit has several advantages in that the skin around the dimple remains perfectly flat, fractures around the hole are eliminated, and the angles on the top and bottom of the dimple are exactly the same so that several sheets will nest together for riveting even if dimpled separately. One dimpling tool takes care of any thickness of aluminum, and the hardest aluminum can be dimpled without difficulty.

This tool was specially developed for the aircraft industry, in which it gained an immediate reputation.

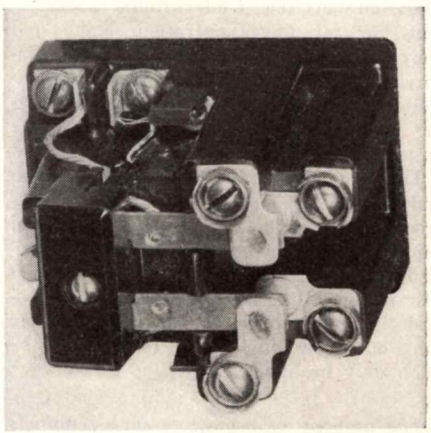
York Electric & Machine Co., 1241 W. King St., York, Pa.

AUXILIARY RELAY

AeroED 2030 (Nov. 1943) . . .

Instantaneous auxiliary relay designed to meet the light-weight and small-space specifications of the Army, Navy, and Air Corps.

This new auxiliary relay, *Type HMA*,



weighs 9 oz and is 1⅞ by 2¾ by 2-9/16 in in size with its cover. Its base, cover, and moving contact supports are of one-piece molded Textolite (see Illus.). The relay is available in the following styles: double-pole, double-throw with single-break contact; single-pole, double-throw with double-break contact; single-pole, and double-throw with double-break contacts brought out to a terminal. It can be obtained back or front connected; with or without cover. Contacts of the relay are silver to silver, self-aligning, and will interrupt 1 amp at 125 v dc inductive load. Screws for front connections and studs for back connections are readily accessible.

•

Every requirement of military and naval aircraft appear to be met in this design.

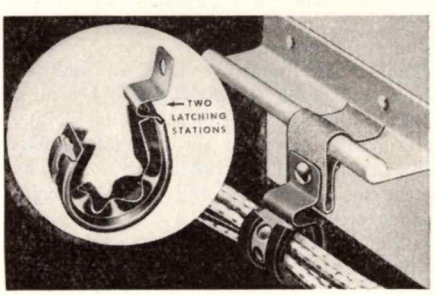
General Electric Co., Schenectady, N. Y.

LATCHING WIRE HARNESS CLAMPS

AeroED 2031 (Nov. 1943) . . .

Wiring harness clamps with a latching finger.

These clamps work independently of the attaching screw in the assembly of wire harnesses and any or all of the wires may



now be removed or replaced without even loosening the screw that holds the clamps in position. These clamps are used in place of "boggles" at the point of make-up, remain snapped over the wires during trans-

portation to final assembly location and then serve as the mounting means for attaching harness to structure. Made of spring steel Parkerized and given two coats of lacquer, they are cushioned with extruded synthetic rubber channels having integral resilient ribs to absorb variations in thickness of harnesses.

Two different latching stations are provided on each clamp for size adjustment to fit varying numbers of wires. With the resilient ribs and the adjustment feature, six sizes accommodate wire bundles varying from 1/16 in to 1⅜ in dia.

•

The clamps have proved real time savers in aircraft assembly work, and the latching finger shown in the illustration is both easy to operate and reliable in operation.

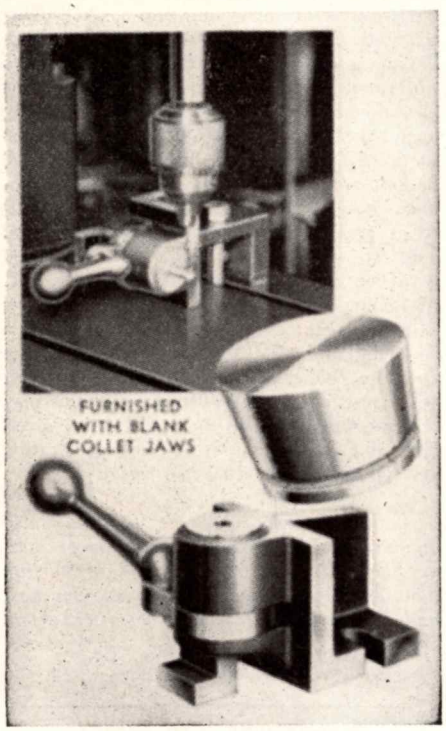
Tinnerman Products Inc., 2071 Fulton Road, Cleveland, Ohio

COLLET CHUCKING FIXTURE

AeroED 2032 (Nov. 1943) . . .

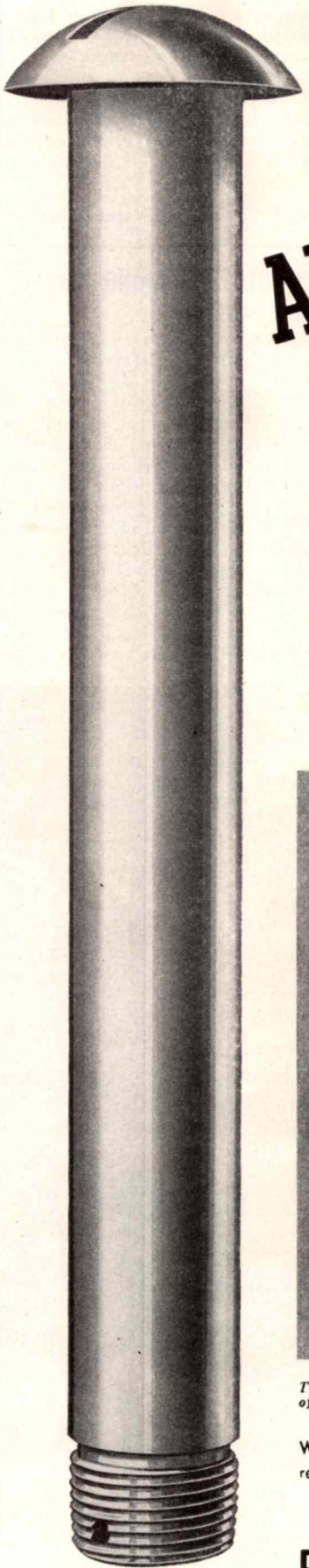
Collet chucking fixture that is useful in the machine shop or production line in getting ready to handle new jobs.

This fixture is designed to use a four-piece spring actuated collet so that the collet

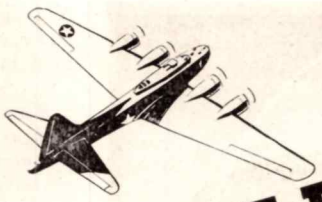


jaws can be furnished undrilled and permit the operator to drill the jaws quickly to hold any special or decimal size or unusual shape. The work can be done right on the machine assuring accurate centering with the tool and jaws may be hardened for longer runs. Jaws grip surface in complete 360° span. Blank jaws are held together with a retainer ring and may be kept in the bin ready for use at any time. They are furnished in either cold rolled steel or tool steel.

The fixture accommodates stock from zero to one inch, although the size is limited to 9/16 in if the stock must pass through the collet. The fixture itself has a very convenient means of quick locking and unlocking.

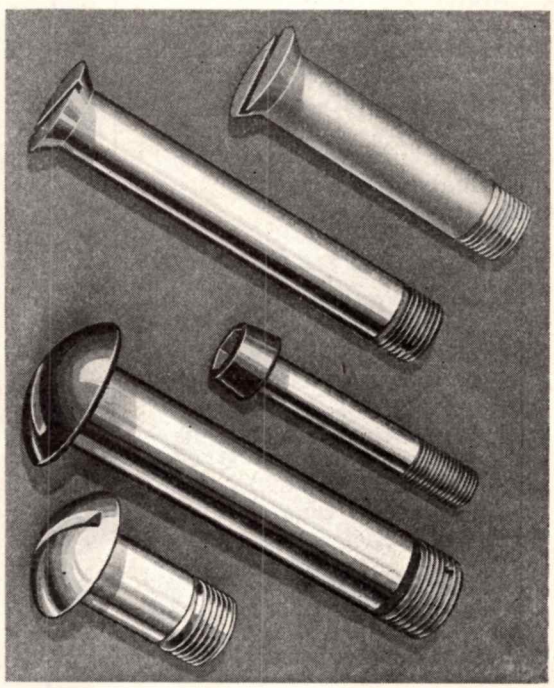


Clevis Bolt for landing gear of heavy aircraft (actual size).



AIRCRAFT BOLTS BY RITCO

To meet the exacting requirements of today's Aircraft Industry, we are proud to be able to supply special bolts in the larger sizes. Furnished to AN Aircraft Bolt Specifications or NAS Close Tolerance Specifications, etc. These bolts are manufactured of Aircraft Alloy or High Carbon Steels from 9/16" to 1¾" diameter . . . special heads as specified.



Typical Aircraft bolts produced by RITCO. Shown are samples of 82° Angle Bearing Bolts, Internal Wrenching Bolts and Clevis Bolts.

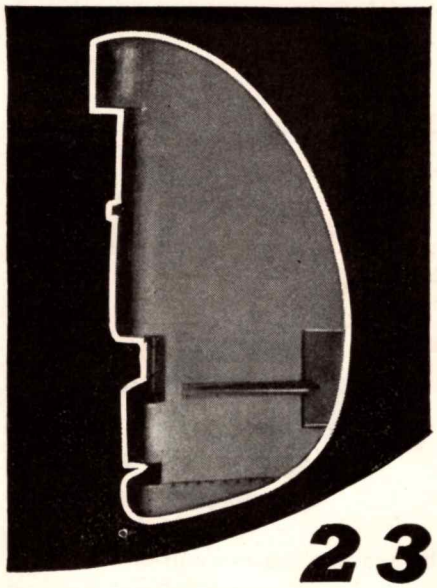
We shall be pleased to quote on your special aircraft bolt requirements

◆

RHODE ISLAND TOOL COMPANY

148 W. River St., Providence, Rhode Island

Serving American Industry since 1834



23 years

OF EXPERIENCE in fabricating aircraft . . . personnel skilled in working with aluminum, aircraft steels and fabric . . . specialized equipment for forming, assembling, treating and finishing the job completely . . . the capacity to make deliveries on schedule . . . these advantages make Mercury a logical source for aircraft surfaces.

accessories, too

Oil Separators for deicing equipment, Flier's Relief Tubes and Fittings and Communication Sets for training planes are typical of the many aircraft accessories produced by Mercury in quantities which assure rush shipments.

NAF-47089

We are able to make especially quick delivery on this widely used Navy Oil Separator.

AT *The Cradle of Aviation*

MERCURY AIRCRAFT INC.
HAMMONDSPORT NEW YORK

Slots provide easy attachment to bed-plate and machined surfaces allow the fixture to be used in many different positions.

○

We like a number of excellent features such as the instantaneous release or locking, the ability to handle locks in a number of convenient positions, the simplicity and strength of the picture.

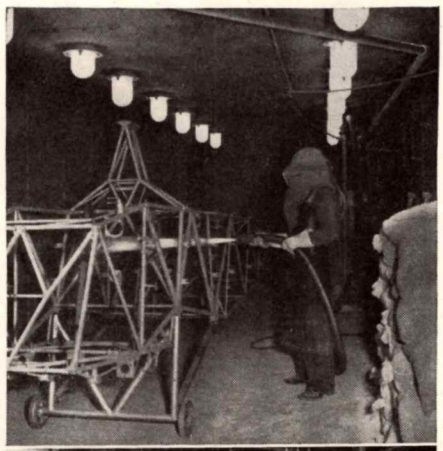
Wayne Pump Co., Fort Wayne 4, Ind.

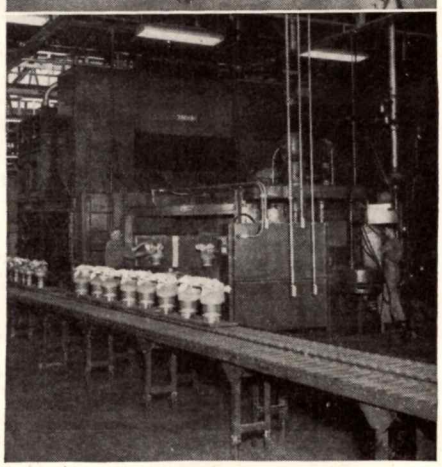
BLAST CLEANING

AeroED 2033 (Nov. 1943) . . .

Air blast room for the cleaning of aluminum and magnesium fuselage frames.

The entire fuselage to be cleaned is wheeled into the *Airblast Room*. Bright overhead lights and a fine system of ventilation keeps visibility at maximum efficiency while the helmet protected operator quickly blasts the desired finish on the metal frames. A fine sand is discharged by compressed air from the nozzle in the end of the hose line thereby giving a uniform light finish to the tubing without the danger of "deep biting" or "over blasting." *Blast Cleaning* is also used in the production of airplane engines. A special automatic airblast cabinet puts a uniform finish on the thin fins of airplane





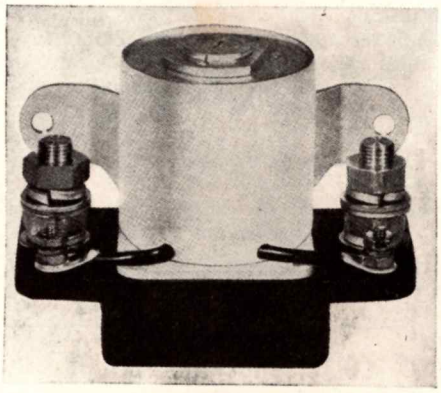
cylinders prior to their being metallized. This saves time and gives a finish that assures a permanent bond for the metal coating.

•

An excellent accessory for aircraft production. The first illustration is particularly striking and shows an operator blasting the metal fuselage of the well known Fairchild trainer. In the second picture a conveyor is shown bringing the engine cylinder to the cabinet.

Pangborn Corp., Hagerstown, Md.

SOLENOID CONTACTOR



AeroED 2034 (Nov. 1943) . . .

Two solenoid contactor units (*B-4 and B-5*) for remote control of electrically actuated aircraft armaments, instruments, and devices.

The *B-4* type, originally designed for airplane starting motors, may be used for other applications of heavy current control. This solenoid contactor operates on 24 v producing a coil current of 300 ma. Contacts are rated at 200 amp at 24 d-c. The unit has double pole, single throw; normally open contacts; and weighs 31 oz and has its metal parts plated to withstand a 200 hr salt spray test. It is claimed that it resists acceleration and vibration over 10 times gravity and operates in any position. The *B-5* series has a contact rating of 50 amp continuous and operates on 24 v d-c, producing a coil current of 210 ma. It has a double pole; single throw; normally open contacts; and weighs 11.2 oz. Similar to the *B-4*, the *B-5* can withstand the 200 hr salt spray test, and is so constructed that it may be disassembled with pliers and screwdriver. The unit is also said to resist acceleration and vibration over 10 times gravity.

•

A five aircraft relay the B-2-A is also announced. The above contactors meet AAF specifications for remote control of starting motors, and will function under extreme heat and cold, are moisture and corrosion proof.

Guardian Electric Mfg. Co.,
1615 West Walnut St., Chicago, Ill.

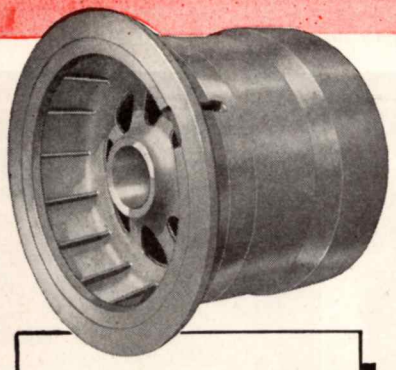
PARACHUTE WEB TESTER

AeroED 2035 (Nov. 1943) . . .

Precision hydraulic testing machine which determines the strength and resilience of parachute webbing.

The photograph shows that the machine is a simple one. All breaking loads are measured by gravity stress acting on a pendulum and this assures continued accuracy for there are no parts of the weighing mechanism which are subject to changed characteristics due to metal fatigue. The testing apparatus has a maximum loading capacity of 10,000 lbs and can accurately register load tests as low as 50 lbs. The special type web grips, which are shown

(*Continued on page* 332)



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MAGNESIUM
AMPCO BRONZE
BRONZE
BRASS

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means
WELL-CAST

ONLY SKILL AND EXPERIENCE PRODUCE THE MASTERPIECE

GLASS BLOWING, one of the ancient crafts, requires the same high degree of alertness and physical fitness identified with a good foundryman. These are among the qualities contributing to the excellent quality of workmanship found in Wellman castings.

• Our long experience in Ampco Bronze, Well-Cast Magnesium, Brass, Bronze and heat treated Aluminum Alloys is available to your engineering department.

• Patterns of all sizes and kinds in metal or wood.

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TO RESPONSIBLE PEOPLE

INGENUITY
along with extensive facilities for Making or Bettering anything made from metal... large or small Parts... Complete Assemblies...experimental pieces or mass production.

AFTER VICTORY

Booklet Now

To better portray the Spirit back of the services Spriesch is arranging to render...we offer NOW to Industrial Executives an 8-page, 8½ x 11" booklet

WHEN THE SHOOTING STOPS!

★

This booklet contains provocative-thinking based on our own broad experience.

Spriesch has produced continuously huge quantities of intricate mechanisms used to release aircraft bombs...started long before Pearl Harbor...serving the Navy and Army, the latter since 1928.

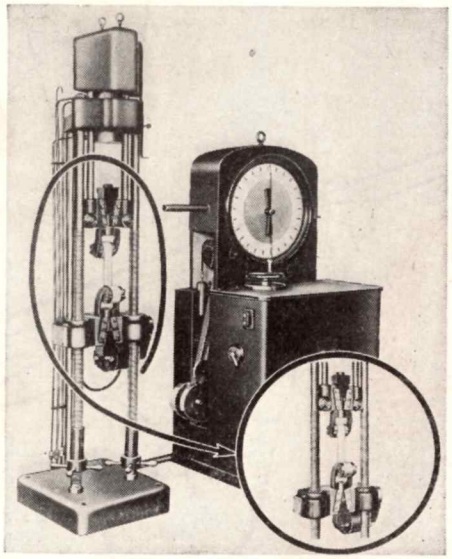
Industrial Executives are invited to write (on business letterhead, please) for this informative, thought-provoking booklet.
Joseph J. Cheney, Pres.

Ao No. 22

★
Spriesch Established 1928
TOOL & MANUFACTURING CO., Inc.
14 HOWARD STREET BUFFALO 6, N. Y.

(*Continued from page* 330)

inset in the illustration, enable quick, easy attachment to the ends of samples up to 3 in wide. Max testing speeds of up to 12 in per min enable the making of 60 tests per hr.



The machine is practically fool-proof which is a decided advantage in these busy times. It should add to the safety in landing of our paratroopers.

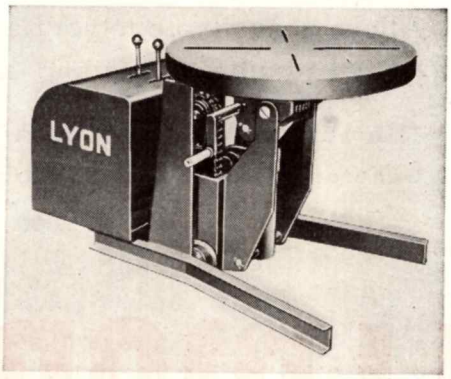
Riehl Testing Machine Div., American Machine & Metals, Inc., East Moline, Ill.

WELDING POSITIONER

AeroED 2036 (Nov. 1943) . . .

Welding positioner to facilitate the handling of complicated pieces.

This new welding table enables the work to be placed in the most convenient position for welding. It tilts from its horizontal position to a vertical position, and lifts up to 14 in. Both of these operations are accomplished by means of a motor-driven hydraulic pump under hand lever control. The table may also be revolved 360° by a hand crank operating a worm and worm-gear and may be specified with variable-speed power revolution. The revolving of the table may be accomplished whether the table is horizontal or vertical, at any point in between, or at any elevation and it is self-locking at any point in revolution. The top of the positioner may be removed by taking out four cap screws in the top plate. This enables welding fixture to be substituted for holding any unusually shaped work. The table top is 30 in in dia and has tee slots. The lowered height to top of table in horizontal position is 30 in (2¾ less to top plate with table removed), while the elevated height is 44 in. The capacity is 2000 lbs.



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The pictures appearing in the bulletin are quite convincing. With the aid of the table, any welding position can be secured. With the table removed and a jig substituted, the most complicated piece can be conveniently handled.

Lyon-Raymond Corp., Greene, N. Y.

AUTOMATIC SCREW MACHINE

AeroED 2037 (Nov. 1943) . . .

Precision automatic screw machine for accurate, high speed, automatic screw machine production.

The new screw machine is adapted to turning parts such as pinions, shafts, screws and small slender parts used in clocks, meters, radio equipment, precision instruments, guns and aircraft engines. Diameters from .005 in to 7/16 in and lengths from 1/32 in to 2¾ in are covered by its wide range of work. In addition to step and contour turning and chamfering, the machine, with attachments, automatically performs centering, drilling, threading and slotting operations. It maintains unusually close tolerances in production and produces a high finish, usually eliminating subsequent finishing operations. The operating method is as follows: The stock is fed to the 5-station multiple tool head by means of a cam through a bushing and past the cutting tools which are stationary in the horizontal plane. Thus, the side thrust of the tools is at the point of work support. The five tools on the tool head are adjustable radially and axially by means of micrometer screws graduated in .0005 in. The hardened tool holders will accommodate tools up to 5/16 in sq. The two lower tool slides are mounted on a rocker which has a fixed ratio to cams of 3:1. Because of the rigidity of the rocker assembly, which is mounted on a radial ball bearing with an end-thrust bearing, rocker tools are recommended for turning the most important diameters. The cam to work ratio of the other three tool slides is variable from 2:1 to 3:1. The nitrided steel spindle is fitted in a bronze tapered bushing with preloaded precision ball thrust bearings and is dynamically balanced. The entire assembly is enclosed in the semi-nickel steel headstock mounted in a scrapped and gibbed

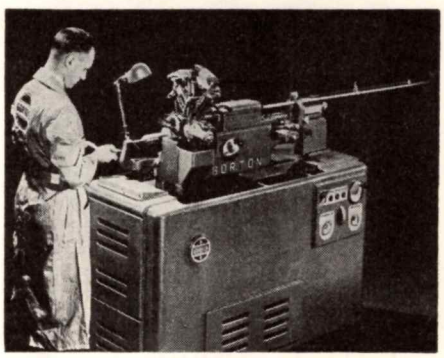


Figure 1

slide on the bed. Tool marks on the work are eliminated by the flat endless woven drive belt. Stock is fed through the guide bushing into the tools, all longitudinal feeds being accomplished by feeding headstock forward as a unit, with bar held in spindle collet in the usual manner. The cam controls these movements, both forward and back. Synchronizing this longitudinal cam

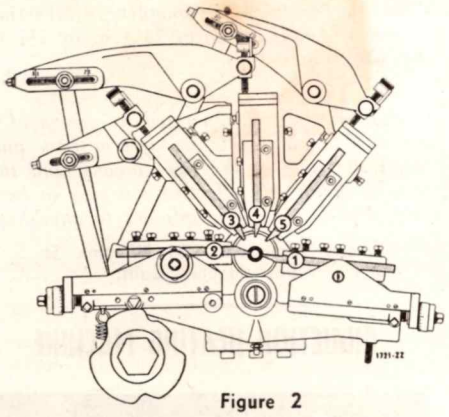


Figure 2

movement with cams which control the lateral movement of the tools permits generating any desired shape with single point tools. The gear-type coolant pump and ¼ hp motor are mounted as a unit in a seperate compartment at rear of the machine and the entire unit is conveniently removable for inspection and cleaning. The 12-gallon reservoir has a removable pan, baffles and strainer. There is a shut-off and relief valve on the pressure line and a filter on the intake. The three-spindle attachment mounts on the base in front of the tool frame. It centers, drills, then threads the piece, either internally or externally. Threading spindles work on a speed differential system, eliminating the necessity of stopping the work spindle, or of providing special headstock speeds for threading operations. The single-spindle drilling attachment also mounts in front of the tool frame. Forward movement of the drill is controlled by a cam which permits spring withdrawal of the drill at spaced intervals for chip clearing. A built-in automatic 5-digit counter registers production quantities. A stock supply signal automatically stops the machine when the stock limit is exceeded and flashes a red light, indicating that re-stocking is necessary. An extension service light, with 30 ft cord, conveniently reaches all parts of the machine.

•

The illustration is of interest. Fig. 1 shows the generally streamlined and neat appearance of the machine while fig. 2 gives a front view of the multiple tool head with radial tool slides. The machine is an American development of a fine design of Swiss origin, and constitutes a real advance in the art.

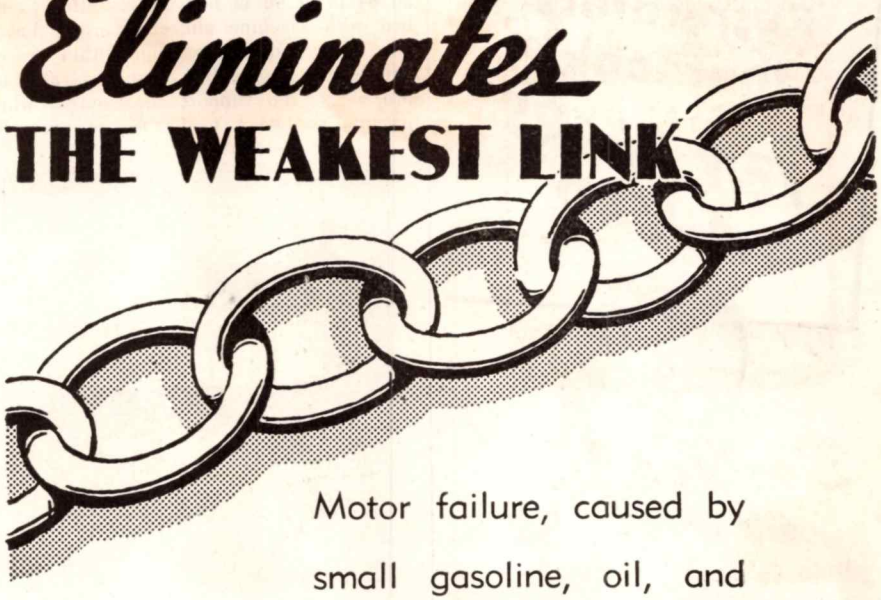
George Gorton Machine Co., Racine, Wis.

HYDRAULIC PRESS

AeroED 2038 (Nov. 1943) . . .

Modern press that fulfills requirements of speed and dependability.

Eliminates
THE WEAKEST LINK



Motor failure, caused by small gasoline, oil, and power leaks, was once aviation's weakest link. When TITESEAL was developed at Wright Field, it stopped these leaks and made aviation safer.

Today, TITESEAL is in constant use by 75% of the makers of aircraft, by commercial lines, and in Army and Navy aircraft all over the world.

Always specify TITESEAL, the modern sealing compound. Made in densities to fit every gasketing and sealing need.

PERMITS EASY Disassembly

For detailed Information Write

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TiteSeal IS Indestructible

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■ **Pulmonary diseases do not always strike quickly. Often they wait two, five or even fifteen years from the time of exposure.**

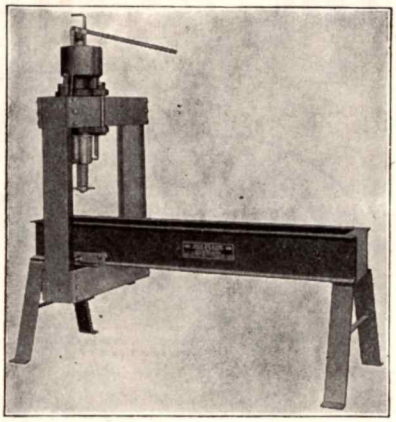
Willson has long studied occupational diseases—and the dusts which produce them. And the many respirators which Willson has designed to *protect* against these dusts have won the confidence of safety executives all over the world.

All Willson protection is scientifically engineered to provide the utmost in safety and comfort. That is why so many Safety Directors and Purchasing Agents specify Willson for head, eye and lung protective products. For over 73 years Willson has been a leader in the field of accident prevention.

GOGGLES • GAS MASKS • HELMETS • RESPIRATORS

DOUBLE WILLSON PRODUCTS INCORPORATED
READING, PA., U.S.A. *Established 1870*

The press as illustrated is available with an 84 in or 96 in bed and is fitted to the bed with machine slides in order that it may be moved to any point within the entire length of the bed. Range is also improved by the support construction which permits the head to be moved crosswise.



The press has 16 in clearance between the end of the ram and the top of the bed: ram travels 7 in and quick-acting screw in ram travels 7 in, making a total stroke of 14 in obtainable.

•

The press is suitable for almost any type of pressure work within the limit of 50-ton capacity; is fast and reliable.

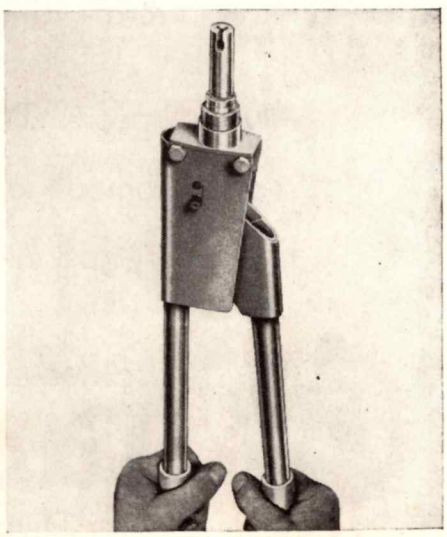
Bee Line Co., P.O. Box 569, Davenport, Iowa

RIVET GUN KIT

AeroED 2039 (Nov. 1943) . . .

Rivet gun kit known as G-10 is used to aid field service and repair men in heading up rivets and servicing operations where air power is not available.

The principal feature of the kit is its complete complement of pulling heads and



other convenient accessories for the G-10 hand gun. Hand gun operations are not necessarily confined to emergency repair jobs in the field, but are proving helpful in factories and modification centers where the time involved in connecting compressed air equipment for certain jobs is not warranted. The kit also contains right angle adapter used in inaccessible places that cannot be reached through a straight pull in line with the axis of gun head. Six interchangeable pulling heads are also included for sizes ⅛ in, 5/32 in and 3/16 in standard diameter rivets, one each for countersunk and brazier type head in all sizes.

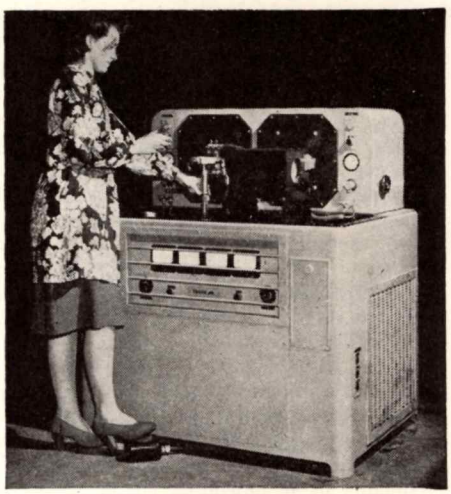
Flat ground nippers for trimming stem of self-plugging rivets are recommended to go with kit but are not standard equipment. The kit contains a complete instruction sheet. The case measures 23⅓ in by 7¼ in by 2 3/16 in.

•

Pulling force is generated by means of a ratchet which exerts an intermittent pull until the stem of the rivet breaks, and the gun is thoroughly effective and easy to handle. The kit is a fine adjunct to any shop.

Cherry Rivet Co., 231 Winston St., Los Angeles, Calif.

INDUCTION HEATING MACHINE



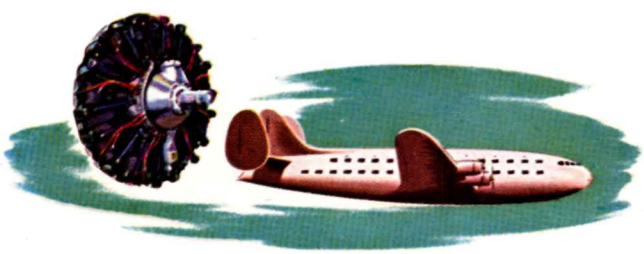
AeroED 2040 (Nov. 1943) . . .

Line of flexible 15 kw output *Tocco Junior* induction heating machines.

Suited to a wide range of induction heating applications, this small *Junior* machine provides every advantage of the *Tocco* process. It can be adapted to brazing, annealing, heat-treating, heating for forging and surface hardening of small and medium-sized parts. Steel construction is welded and rugged, capable of providing continuous operations around the clock with a minimum of maintenance and care.

The unit includes a special sturdy 20 hp motor generator set insuring a dependable source of power which maintains accuracy of heat control at all times. This is especially so for the brazing of small parts such as carbide tips where fast, controlled heat is needed. Additional items easily brazed include tube fittings, shell adapters, burster tubes and many others. The machine occupies 48 in by 32 in of floor space and stands 51 in high with the work pan set 35 in above the floor at "work-easy" level, and is of moderate weight. It fits a production line without necessitating major shop alterations for only three connections are needed—two for water and one for power, 220/440 v. The unit offers pre-set automatic controls, quenching auxiliaries, transformers, capacitors, "fool-proof" meters and

(*Continued on page* 337)



This measuring glass contains slightly over half a pint of gasoline. Mixed with about 75 cubic feet of air and metered into a Cyclone 9 engine, this cupful of fuel, in contributing its share of the total power, will produce one horsepower for one hour.

No other type of gasoline engine does as much work on this amount of fuel; your car would require about 20% more gasoline to produce 1 horsepower for 1 hour. In engineering terms, the Cyclone's cruising consumption is at the rate of 0.41 pounds of fuel per horsepower per hour. Cyclones have operated on extended flights at cruising power on 0.39 pounds per horsepower hour — even less under careful control — but 0.41 represents the average for millions of hours of routine operation.

Minimum fuel consumption is determined by the engine design, depending on such factors as the compression ratio, the induction system, and the contour, size, and cooling of the combustion chamber. The carburetor's function is to provide the most desirable mixture for its engine under various conditions, but it cannot determine fuel economy because an engine will not run leaner at a given power than its design permits.

On a ten-hour flight in a four-engined airplane the seemingly fractional difference in consumption between the Cyclone 9's average lean rate of 0.41 lbs. and the general average rate of 0.45 lbs. can amount to a saving of 160 gallons. The fuel saved with Cyclones represents almost 1,000 pounds of extra cargo or five additional passengers. In a year, this difference can mean a saving of 50,000 gallons on a four-engined plane — fuel approximately equal in cost to an engine.

★ ★ ★

Wright Cyclones pay their way.

Cyclones and Whirlwinds · Light · Compact · Powerful **WRIGHT** *Aircraft Engines*

More Cargo, When They Fly With Their Boots On

Cargo planes are performing heroic service ferrying men and supplies to the fighting fronts. Almost always loaded to capacity, they are constantly subjected to terrific vibration stress by engines which must strain to the limit to lift the big ships from the ground and keep them in the air. That these planes are able to "take" severest vibration without "coming apart at the seams," is due largely to the vibration-proof Boots Self-Locking Nuts which protect them.

Boots Nuts are not only tough, they are also lighter than other nuts, save many pounds on each plane . . . thus allow for more cargo. In addition, they can be used and re-used as often as desired—literally "outlast the plane." Boots Self-Locking Nuts, standard for every type of U. S. aircraft, meet the exacting specifications of all government aviation agencies.

VIBRATION May Have Caused This

Common causes of mechanical failure of automobiles are vibration-loosed connections. And loose connections can result in anything from an annoying body squeak to a loose wheel—and a serious accident. The answer to any vibration-loosed connection is a vibration-proof fastening. After Victory, automobile manufacturers with an eye to added driving safety will protect their cars with Boots Self-Locking Nuts which withstand severest vibration.

BOOTS

Self-Locking Nuts For Application In All Industries

BOOTS AIRCRAFT NUT CORPORATION ★ GENERAL OFFICES, NEW CANAAN, CONNECTICUT

(*Continued from page* 334)

push-button starting and stopping. Timers are placed on the front panel beneath the work pan flanking the clear vision meter board which is protected by a grill and operating devices are conveniently situated. Protecting the air-cooled motor compartment from shop grime and dust are filters set behind the ventilating louvres. Including the new unit, the seven 9600 cycle *Tocco Junior* models have the following output ratings: 15KW, 20KW, 50KW, 75KW, 100KW, 125KW and 200 KW, while larger machines are available with up to 800KW output rating. For these special large part units, frequencies are in the lower classifications.

•

Noise and vibration have been reduced to a minimum and it requires no great electrical skill to operate this equipment. The compact dimensions make it possible to move and install the units readily wherever required. Women operators can manage the units with ease.

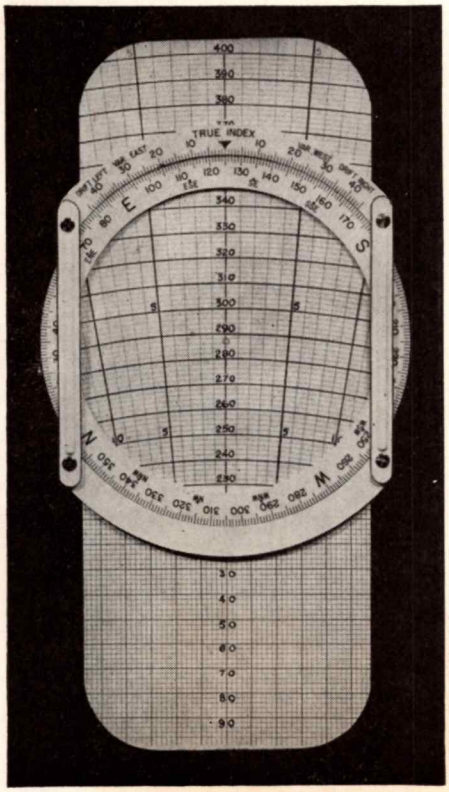
Ohio Crankshaft Co., 3800 Harvard Ave., Cleveland 1, Ohio

A PLASTIC COMPUTER FOR AIR NAVIGATION

AeroED 2041 (Nov. 1943) . . .

The Dalton Computer, E-6-B, standard equipment for the Army and Navy Air Forces.

The slide rule side of the computer, readily solves the true altitude from the calibrated altitude, and vice versa; the true airspeed

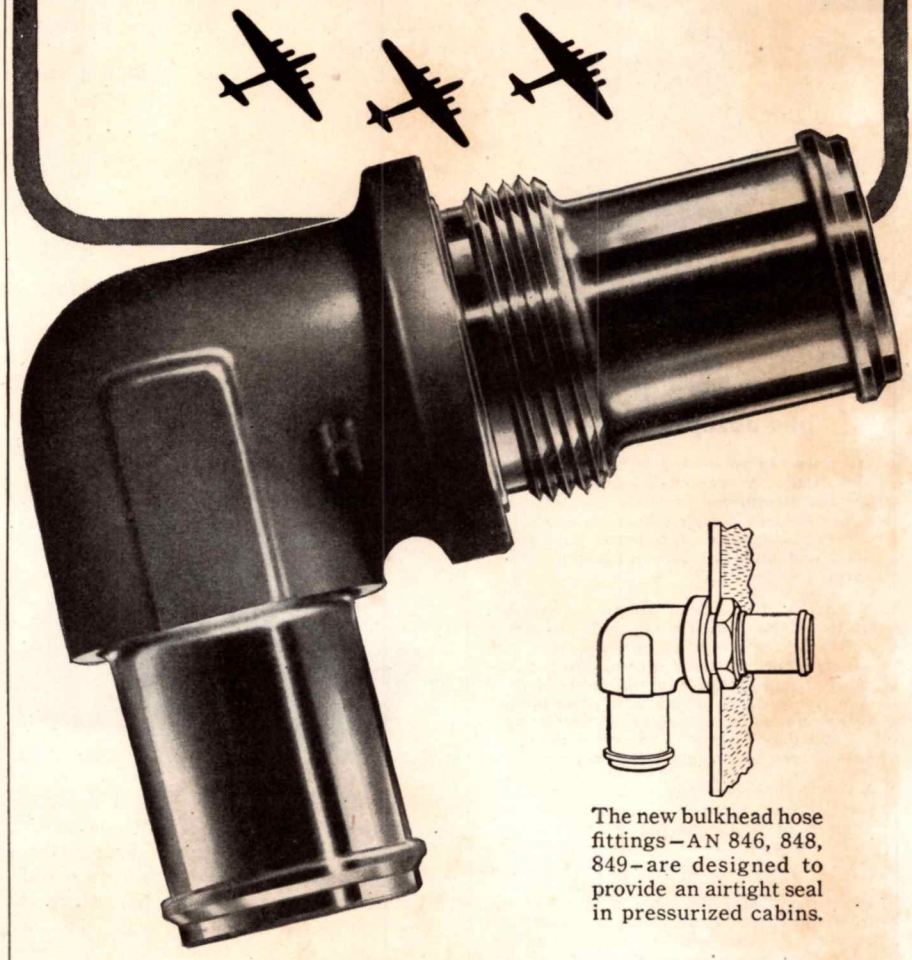


from the calibrated airspeed, and vice versa; and deals with multiplication, division, and proportion problems, such as time-speed-distance; gas consumption; conversion of arc to time; interconversion of statute miles, nautical miles, and kilometers; and solution of the equations of radius of action. The

NEW **DURAL**

BULKHEAD FITTINGS

FOR PRESSURE CABINS



The new bulkhead hose fittings—AN 846, 848, 849—are designed to provide an airtight seal in pressurized cabins.

EARLY DELIVERY ASSURED

Hartwell's new Dural bulkhead hose fittings—AN 846, 848, 849—are available in thread diameters ranging from ¼" to 1½". These fittings provide a thread relief space, one and one-half threads wide—between the shoulder and first thread—to permit the lock nut to be tightened against a thin bulkhead partition. An extra thread allows for partitions of varying thickness.

Special tooling, inspection after each operation, and final inspection before shipment are enabling us to hold close thread tolerances and i. d. and o. d. dimensions. All fittings, except those made from barstock, are pressure tested.

We also manufacture the AN 840-847 series and are tooled to produce fittings from manganese bronze as well as Dural.

HARTWELL AVIATION SUPPLY COMPANY

Aircraft Production Parts

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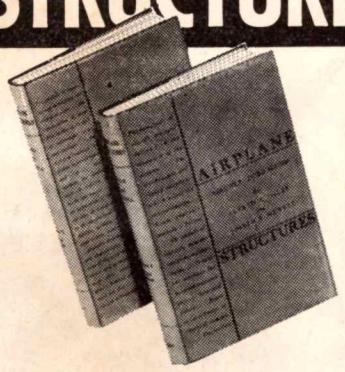

by Alfred S. Niles and Joseph S. Newell

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vector side of the computer, shown in this illustration, finds wind, groundspeed and heading, and track and airspeed.

•

The instrument is accurate, compact and can be worked rapidly. It is serviceable and can stand a lot of handling.

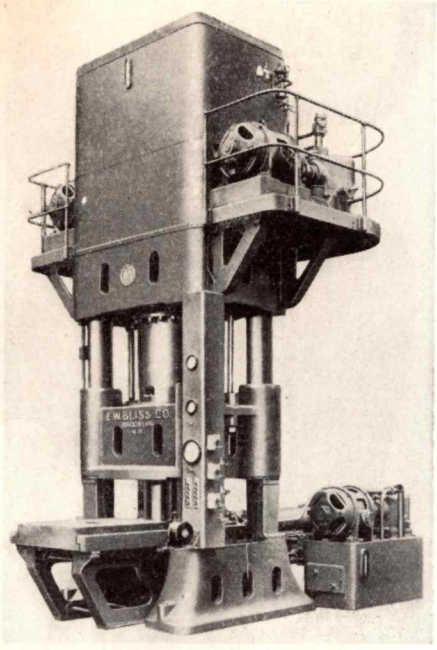
Weems System of Navigation, Annapolis, Md.

SELF-CONTAINED HYDRAULIC FORGING PRESS

AeroED 2042 (Nov. 1943) . . .

1100-ton self-contained, electrically controlled hydraulic forging press equipped with a sliding die table and a 35-ton ejector for the manufacture of aluminum billets and drop forgings.

The press controls are interlocked so that



the press, die slide and ejector operations can occur only when the different actions are in their proper positions. Four methods of operations are provided for the main slide. First is semi-automatic operation where the press completes one press cycle and then stops. Second is full automatic operation where the press slide operates continuously until the stop button is depressed. The sequence on these two methods may include the operation of the die slide and the ejector.

The third method of operation is, joggling control by means of a drum type switch permitting small reciprocations of the press by the use of the switch and retaining quick advance and quick return features. The quick advance of this press is 750 in per min, the return speed is 725 in per min, and the pressing speed is 37 in per min. The fourth method is the inching control which permits small increments of approach of the press by the use of a push button, the press descending only as long as the down button is depressed and opening only as long as the up button is depressed.

This inching control safeguards the unit against over-pressure and over-travel. When using the third or fourth methods, the pressure switch may be set for reversal and this reversal will function even though either the joggling lever or the inching button is held in the down position, the press reversing at the predetermined pressure. The press is powered by a 150 hp pumping unit. The die slide is operated by a separate pump which is used for actuating the ejector in the die slide or interlock, the two not functioning at the same time.

•

The "universal" control features of this press have now given more than two years satisfactory service in the manufacture of aluminum billets and aluminum drop forgings, and presses of this design are available up to capacities of 1500 tons.

Hydraulic Sales Dept., E. W. Bliss Co., 53rd St. & 2nd Ave., Brooklyn 32, N. Y.

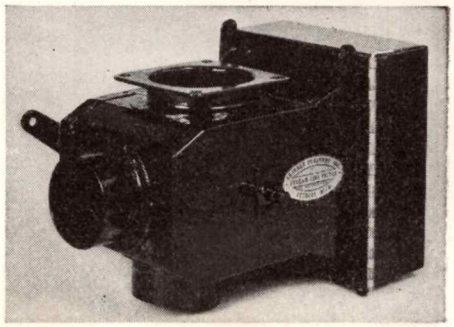
AIR SCOOP AND FILTER

AeroED 2043 (Nov. 1943) . . .

Combination air scoop and filter to improve airplane engine carburetion.

Full control of either hot or cold air, or the correct balance of both is accomplished in the scoop itself, whose total weight is 2.67 lbs. A basic feature in the scoop is the location of the butterfly valve, pivoted close to the center of the scoop housing instead of at the bottom, as is now commonly done. This valve is pivoted slightly off-center on the ram side so that the valve remains closed under normal operation, without aid from ratchets or other devices. When the valve is set for 100% cold air operation, the large outlet pipe on the bottom (as shown in the illustration) permits all hot air to pass off without causing any harm to the hot air stove. This feature permits the interval between stove inspection periods to be greatly lengthened and improves the hot air ram by maintaining the auxiliary dump on the stove.

When a mixture of both hot and cold air is desired, this same outlet pipe permits the balance of the hot air to escape through this pipe, thus preventing turbulence inside the scoop. A smooth and steady flow of air at zero pressure directly below



the venturi provides good carburetion. Removal of the air filter from the scoop requires no tools. Half hinges are spot welded to the scoop and to the filter cabinet. the hinge pins are wired in, but have bent ends which make them easily removed by hand. One-piece construction of the scoop provides for greater structural strength.

When a plane is in a tail-down position, no gasoline can collect in the back end of the scoop because the butterfly valve does not entirely close off the outlet pipe. On the lower front end of the scoop, a small

dam traps any excess gasoline (from a closed throttle at a landing) allowing it to drain off thru two vent holes so located that the gasoline is ejected outside of the cowling.

•

The combination scoop and filter is already standard equipment on many training planes built for the Army Air Forces, and is also quite suitable for installation in light planes. The fact that this device can be dissembled and assembled with ease and that inspection periods can be greatly lengthened with safety commend it to the user.

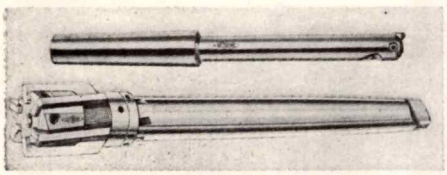
Skinner Purifiers Inc., Detroit, Mich.

BORING BAR & REAMER

AeroED 2044 (Nov. 1943) . . .

Boring bars and reamers which produce a fine finish and high production with accuracy.

The boring bar consists of a taper shank with an adjustable cutting tool built in at the tip. The adjustment is accomplished by turning a graduated adjustment screw which moves the cutting tool in or out. The tool, once set, is firmly locked into position by a wedge locking device. Adjustments up to ⅛ in may be made in the 1 in boring tool model. Boring may be done with precision



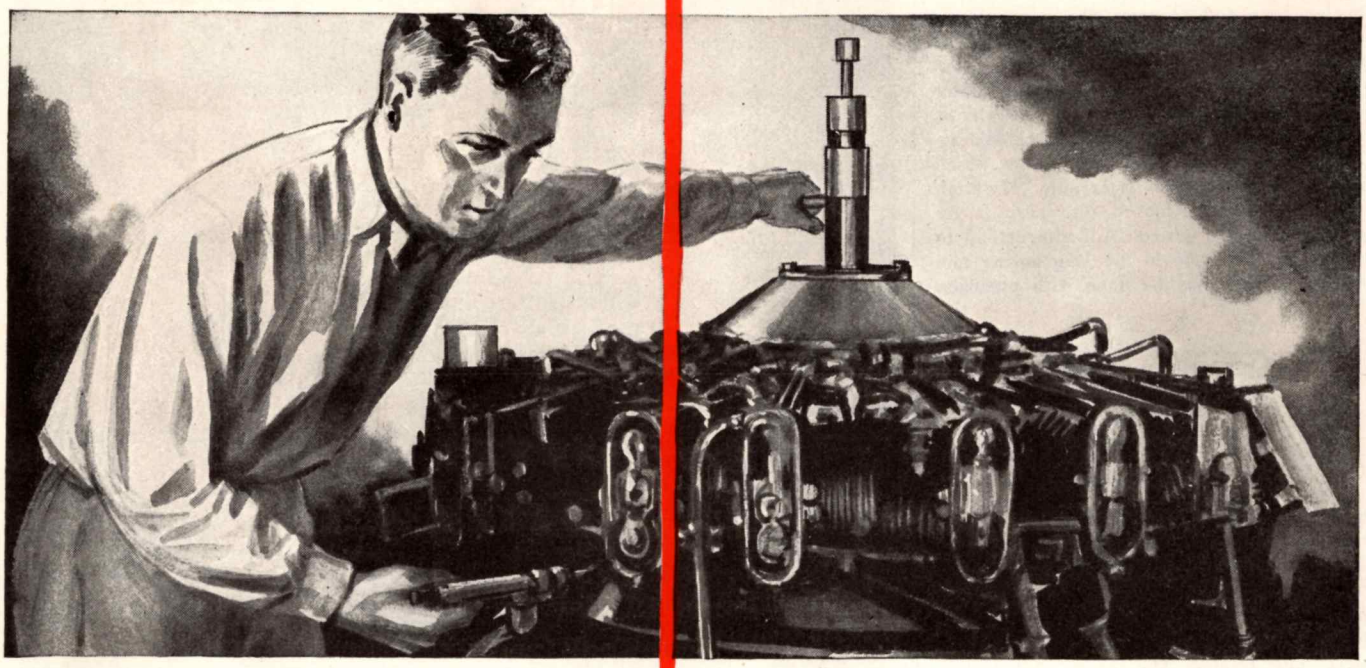
because the boring bar is strong and the cutting tool support is unusually rigid. The boring units are available in several sizes for use in large boring bars, boring and turning heads. The adjustable reamer contains four or more cutting blades of high speed steel—heat treated. The reamer may be obtained integral with the arbor or a separate unit. The blades are inserted at the proper rake angle and are designed to give smooth holes. At the back of each blade is a locking screw which helps support the blade. There is large chip clearance at the front of the blades which permits the application of large quantities of coolant to keep the blades cool and free of chips. Precision adjustment is made quickly to an accuracy of a .001 in by means of a screw. The blades increase the reamer diameter as they are adjusted forward. The blade seats are milled with threads. These threads engage a circular thread on the base of the reamer and are moved forward or back by rotating the base. Adjustment ranges from .034 in on the ⅝ in dia reamer to .420 in on sizes of 3 7/16 in and over. Special boring bar units and reamer units are available which accomplish two or more operations such as roughing, and facing, which is done by mounting additional cutting tools on the arbor.

•

Examination of the literature available indicates that these tools have been designed with the greatest care, that they are robust and readily adjustable. The whole line of boring bars and reamers is in wide

(*Continued on page* 341)

Whiz RUST PREVENTIVES



...the *"liquid packaging"* that gives protection to airplane parts from factory, to assembly line, to battle front...

R. M. Hollingshead Corporation manufactures a complete line of rust and corrosion preventive compounds that meet fully Government specifications. There are WHIZ compounds for the protection of both internal and external surfaces.

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(*Continued from page 339*)

service in some of the best metal working plants in the country.

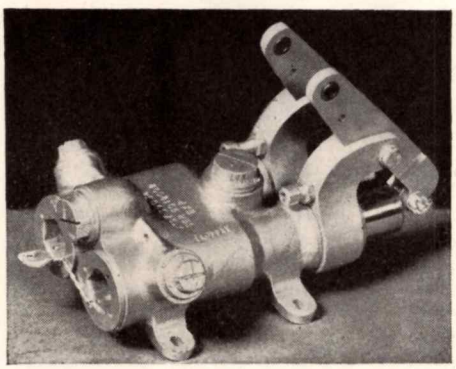
Wetmore Reamer Co., Milwaukee, Wis.

BRAKE VALVE

AeroED 2045 (Nov. 1943) . . .

A simplified brake valve, designed for foot-pedal operation of brakes where the power is supplied direct to the brakes from the main hydraulic system through a hydraulic accumulator.

The new brake valve shown in the illustration has only two moving parts in addition to the lever. The working units are contained in a cartridge which can be readily replaced and easily repaired in the field. It is said to be lighter in weight than other valves of its type, although its over-all dimensions are the same and the weight is 3.25 lbs for a double unit, consisting of two valves—contained in a single housing with levers and return springs, ready for installation in the airplane. Where standard dimensions do not have to be maintained, the valve can be greatly reduced in size and weight. The valve provides sensitive pressure control and will operate all types of brakes now in use without any additional pressure reducing



unit such as a debooster. With proper choice of pedal-operating lever and lever attachment, this type of valve will operate brakes whose maximum working pressure ranges from 175 psi to 750 psi and this sensitivity is indicated by the curve of brake pressure versus lever displacement for a valve set to a maximum pressure of 300 psi as shown in the accompanying graph.

•

A valve of this type is normally used in planes with a gross weight in excess of 12,000 lb. It constitutes a decided advance and can be made interchangeable with other types of power brake valves.

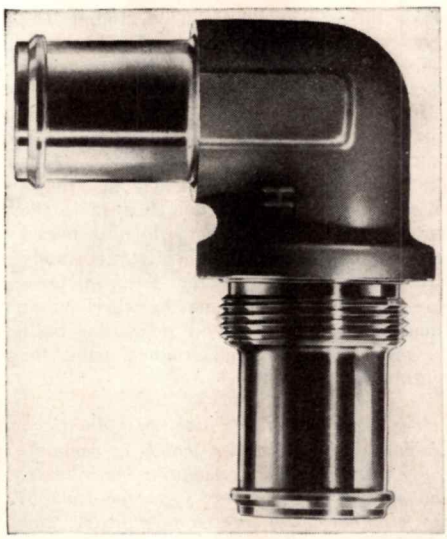
Aircraft Accessories Corp., Burbank, Calif.

BULKHEAD HOSE FITTING

AeroED 2046 (Nov. 1943) . . .

A dural bulkhead hose fitting developed to meet the need for an improved type of fitting for pressurized aircraft cabins.

The hose fitting, in addition to being light in weight, combines in one unit, the job formerly performed by a bulkhead connection and a hose fitting on either end. Made in thread diameters ranging from ¼ in to 1½ in, the new fittings provide a thread relief space, one and a half thds wide,



between the shoulder and the first thread, to permit the lock nut to be tightened against a thin bulkhead partition. They are manufactured to close thread tolerances and id and od dimensions. Except for those made from barstock, the fittings are pressure tested by air, under kerosene, to 100 lbs gage pressure. The above photograph shows an *AN848-20* dural bulkhead hose fitting which is one of the *AN846, 848* and *849* series now being manufactured. Fittings of the *AN840* to *847* series are produced from manganese bronze as well as from dural.

•

The fitting has a neat and effective appearance and has proved well adapted to its purpose.

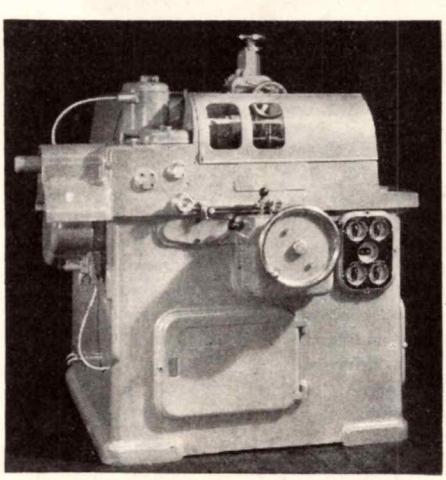
Hartwell Aviation Supply Co.,
3417 Crenshaw Blvd., Los Angeles 16, Calif.

THREAD GRINDER

AeroED 2047 (Nov. 1943) . . .

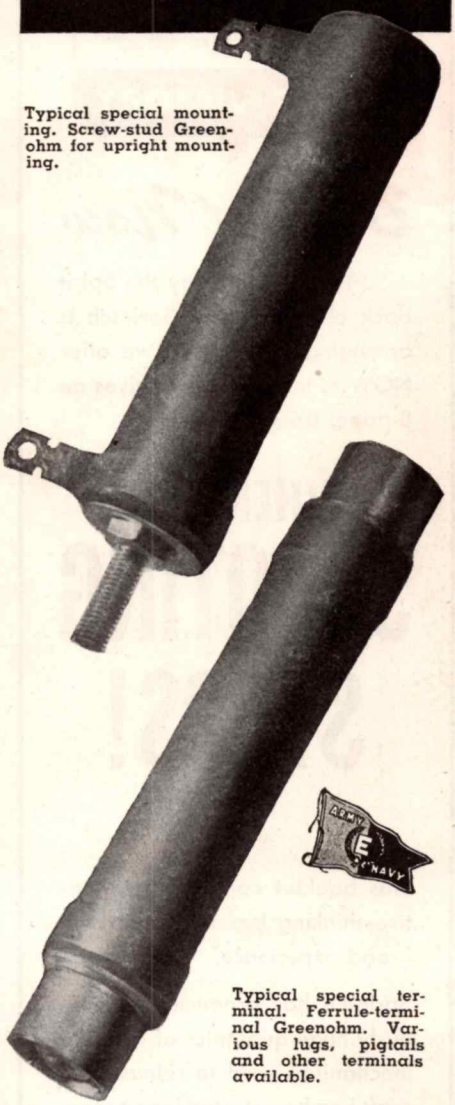
Thread grinder on which either a single-ribbed or a multi-ribbed wheel may be employed.

The machine can be used for precision gage work or straight commercial production, yet has the advantage of simplicity of



operation. Single or multiple right or left-hand threads with any pitch up to 60 thds per in may be cut. Work with a maximum length of 12 in may be held between centers

Special
GREENOHMS



Typical special mounting. Screw-stud Greenohm for upright mounting.

Typical special terminal. Ferrule-terminal Greenohm. Various lugs, pigtails and other terminals available.

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Joseph J. Cheney, Pres.

Ad No. 22

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Spriesch Established 1928
TOOL & MANUFACTURING CO., Inc.
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and a thread 9 in long can be ground. The grinder will accommodate work of a max dia of 7 in, and will grind threads to a max dia of 3 in. Any type of thread can be ground with the wheel properly shaped. Either transverse grinding or plunge cutting may be employed. Two, three or four start threads in most cases may be ground in one pass. An important feature is the multi-ribbed wheel crusher which is forced into the slowly rotating wheel to accurately form the wheel ribs. Another is an oil pressure switch which prevents the wheel motor from starting until the oil pump has built up pressure to a predetermined point for continuous operation.

•

It is claimed that this is the first American designed thread grinder which is commercially available, and it contains many unusual features and advantages—as for example the elimination of precision indexing and additional grinding operations for the second, third and fourth starts.

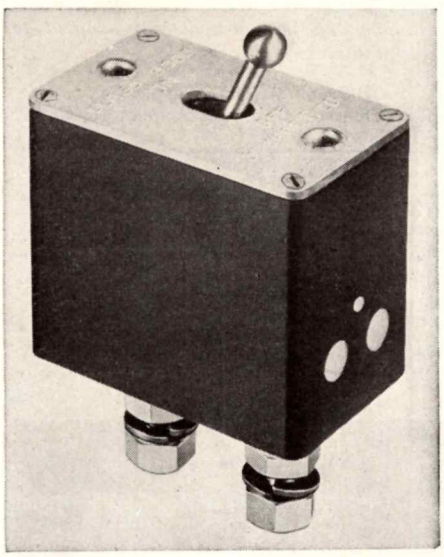
The Sheffield Corp., Dayton 1, Ohio

CIRCUIT BREAKERS

AeroED 2048 (Nov. 1943) . . .

Breaker development in capacities of 80-90-100 and 125 amp at 30 v d-c, supplementing a line having 5 to 70 amp capacity.

A combination of toggle switch and circuit breaker in a single sealed unit (shown in the illustration) saves weight, space, and wiring time. These breakers may be used



for direct control of electric motors, lighting circuits, communication and signal systems or fire control installations. Each breaker is calibrated and factory sealed and no field adjustments are necessary. They have been vibration-tested in accordance with air corps specifications. Acceleration tests show that a force of 10 g's does not cause malfunctioning. The design provides efficient operation when subjected to ambient temperatures of from —50° F to plus 135° F. With ample overload capacity a circuit may be maintained in an emergency due to the non-trip free construction.

•

While these circuit breakers were primarily designed for aircraft, their light weight and excellent resistance to vibration have made them justifiably popular in tanks, boats and other automotive equipment. The non-trip free construction may be particularly useful in the airplane at times.

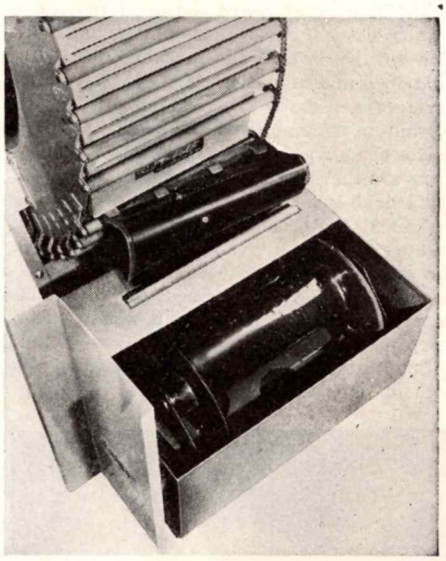
Square D Co., 6060 Rivard St., Detroit, Mich.

FILM-DRYER

AeroED 2049 (Nov. 1943) . . .

Roll-film dryer for aerial photographic work.

It is claimed that the drying of films formerly requiring three hours can now be



done in little more than 30 min. It costs less than earlier designs and it is said that the use of *ARMCO ZINCGRIP-PAINTGRIP* conserves critical alloys. This special zinc-coated metal can be formed or drawn without flaking or peeling of the protective zinc coating and its bonderized surface takes and preserves paint. The dryer is equipped with an electrical heating unit and variable-speed motor. Filters keep out dust, while the blower spreads 2,000 fpm of conditioned air over the traveling film. The dryer takes film up to 9½ in wide and 210 ft long.

•

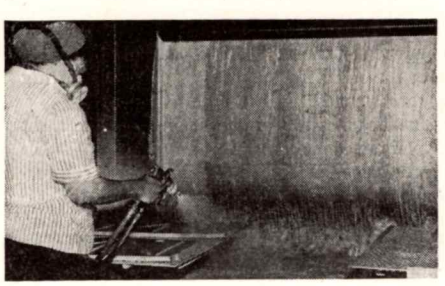
The dryer was developed in cooperation with technicians from Wright Field, and is in use by the AAF in all war theaters. The saving of time made possible by the dryer is invaluable to operations officers after air raids.

Lau Blower Co., Dayton, Ohio

PAINT RECOVERY

AeroED 2050 (Nov. 1943) . . .

A chemical compound added to the water used in water wash spray booths which permits better recovery of paint overspray.



According to recent tests, water treated with the deflocculator produced a recovered paint of the highest quality. The compound was originally designed as a chemical treatment for circulating water systems in paint spray booths, its sole purpose being to prevent breaks in the water curtain by emulsifying oil and resinous vehicles and dispersing pigments so that they could not deposit on the metal walls of the spray booth. Without changing the method or directions for using, the deflocculator serves a double duty, that of a chemical recovery agent, at the same time that the dilute solution of the compound (an initial charge of ⅓ oz to the gal of water, with further additions of 1/6 oz per gal every 4 hours) is acting to prevent breaks in the water curtain. By preventing the formation of scum on the top of the tanks, the deflocculator aids in producing a higher quality of sludge which stays smoother and is dispersed easier after reclaiming. The illustration shows the application of paint by the hand spray method through a smooth unbroken water curtain which is treated with deflocculator to prevent breaks in the watershed and improve the quality of the recovered paint.

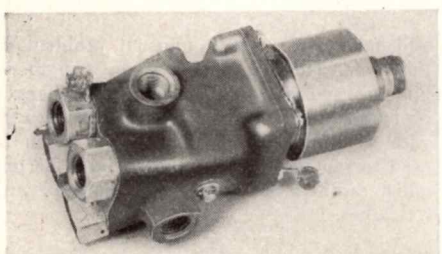
•

The work of hand spraying shown in the illustration was carried out at Vultee Aircraft. It is gratifying to see that the by-product of the process (part of the War Production Board's paint recovery program) is almost as valuable as the primary process itself.

Turco Products, Inc., 6135 So. Central Ave., Los Angeles, Calif.

REVERSING VALVE

AeroED 2051 (Nov. 1943) . . .
Solenoid-operated instantaneous reversing hydraulic valve which stops the motion of aircraft gun turrets.



The most valuable feature of this valve, the manufacturers assert, is its positive and instantaneous action and operating automatically, it stops and reverses the motion of the turret in 1/20 sec. It was originally designed as a turret interrupter, but can be used in any case where it is desired to stop and reverse a movement before a pre-determined danger point is reached. Just before the desired "stop" position of the turret is reached, an electrical circuit is closed, energizing a solenoid, which tips a cam in the valve unit. The cam closes the normal openings of the valve and opens the operating openings, reversing the flow of the hydraulic fluid and hence the motion of the turret.

When the turret has moved 2 in in the reverse direction, the valve automatically returns to normal position and the turret

Packard Aircraft Electric Cable

Up where the air is thin and cold, the problem of safeguarding the surge of electricity that "sparks" engine performance is intensified many times. It has been one of Packard Electric's assignments to develop ignition cable for high-altitude operation, and this Packard cable is now serving in bombers and fighters of America's air forces. Close cooperation with the air forces, aircraft manufacturers and airlines has enabled Packard Electric to apply the full measure of its experience to meeting the requirements of the aircraft industry. Many types of Packard aircraft electric cable are performing varied functions on airborne equipment.

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resumes normal operation. Encased in an aluminum alloy body, the complete valve weighs 3.24 lbs. Each poppet and seat, contained in a cartridge, can be quickly removed and serviced, or replaced, without having to replace the entire valve. Overall dimensions are 2¾ in by 2¾ in by 6 7/16 in. The solenoid is operated on 24 v and draws approximately 15 amps.

•

The valve was developed at the request of a major airplane manufacturer and has proved very effective in preventing overrunning of the turret. The valve is light, simple and easily serviced.

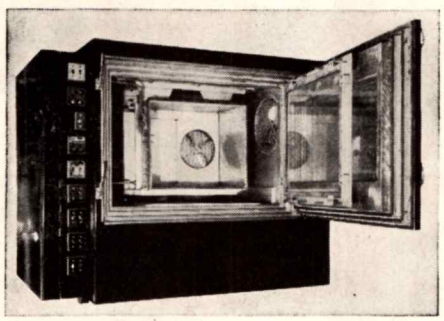
Adel Precision Products Corp., Burbank, Calif.

HIGH ALTITUDE TEST CHAMBER

AeroED 2052 (Nov. 1943) . . .

High altitude test chamber of modern, advanced design.

The new unit consists of a vapor-proof automatic mechanical refrigeration cabinet and an enclosed vacuum chamber with air space completely surrounding it. Above the vacuum chamber a coil of sufficient size is mounted to take care of complete pull down including mass load, heat leakage, etc., of the cabinet itself. This means that the ambient temperature of the altitude chamber will be as low as is necessary for testing within the chamber. The interior of the altitude chamber is equipped with a coil and a forced air unit so that any heat dissipation from motors, etc., may be carried away in the refrigerating system rather than by heat transfer through the wall of the altitude chamber. Thus it is possible to obtain low temperatures quickly and under actual ambient temperature conditions. A heavy glass is mounted on the main refrigerator cabinet door, pivoted at the center and floating on spring bolts so as to maintain alignment upon closing and to give freely under vacuum pressure. The seal to the vacuum chamber is made at the time the refrigerator door is latched and there are no heavy latching



mechanisms or tricky fasteners. With the vacuum-sealed glass-mounting principle the interior of the vacuum chamber can be dehydrated with the overhead coil and then sealed previous to pre-heating for obtaining low relative humidities. This could not be done if cooling were accomplished through the chamber walls or if the chamber were not isolated from the refrigerating equipment. Any changes in test procedure, requiring holes, shafts, electrical leads, etc., affecting the construction of the vacuum chamber, can be made without disturbing the refrigeration equipment. The chamber can be removed intact, revamped or changed, and then reinserted in the cabinet without extensive repairs. Exterior overall measurements are 72½ in by 101½ in by 49 in, including the stand. The height of the cabinet is 66½ in and the switch panel extension is 12 in. Interior (usable space) is 30 in by 24 in by 18 in; cubical contents, 8 cu. ft. Temperature range is —70° C or —55° C, to +70° C and pressure, from atmospheric to 60,000 ft.

•

The test chamber is well adapted to the testing of aircraft instruments and accessories and can meet the widest temperature range likely to be encountered. It is a decided advantage from an aircraft point of view, that so many changes can be made without affecting the equipment as a whole.

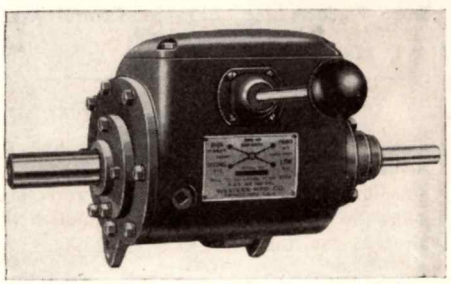
American Coils Co., 25-27 Lexington St., Newark 5, N. J.

TRANSMISSIONS

AeroED 2053 (Nov. 1943) . . .

New transmissions with left hand output used in the motorizing of cone-driven machine tools.

These transmissions come in two types: (1) master (1-5 hp), and (2) major (5-10 hp). Together with multi-motor mount they provide flexibility of application that



will take care of any unusual problem of this type. There is also a super (up to 30 hp) transmission which has eight changes of speeds in geometric progression of 1.29 with a total reduction of 6 to 1, which is used to replace the gear box in large boring mills, radial mills, planers, engine and turret lathes, etc.

•

Nor is the transmission bulky or heavy.

Western Mfg. Co., 3400 Scotten Ave., Detroit, Mich.

ANGLE COMPUTER

AeroED 2054 (Nov. 1943) . . .

Studler angle computer with a 9 in by 16 in surface plate which can handle castings or parts weighing in excess of 75 lbs.

This unit, known as model B, supplements model A which has a 4½ in by 9 in surface plate. These angle computers simplify the layout of die work, survey castings, and inspection of precision-machined parts. The surface plate of the computer is provided with three individual directions of rotation, horizontal, vertical, and radial. The part or casting is clamped to the plate and every

(*Continued on page* 348)

GATE GUARDS ARE
HUMAN

DOUBLE THEIR EFFICIENCY
WITH PEREY TURNSTILES

Gate Guards are subject to fatigue, uneven efficiency and sometimes negligence—they're only human. But—when reinforced with Perey Automatic Turnstile Systems their efficiency is doubled. They can devote full attention to inspection—at entrance against saboteurs—at exit to prevent the unauthorized removal from the plant of expensive, and sometimes irreplaceable tools, precision instruments and records.

CONTROLLED SPEED permits the easy flow of employees through the turnstiles as fast as they can walk—or stops instantly on emergency. The guard's authority is backed up by this subtle combination of psychological and physical influences compelling better behavior.

War Plant Gate Protection involves technical problems that must be solved correctly. Perey Engineers will help you design a system that will best fulfill your desired function. *Write for booklet.*

PEREY SYSTEMS ARE STANDARD EQUIPMENT IN
Aircraft Plants
Navy Yards
Shipyards
Arsenals & War Plants

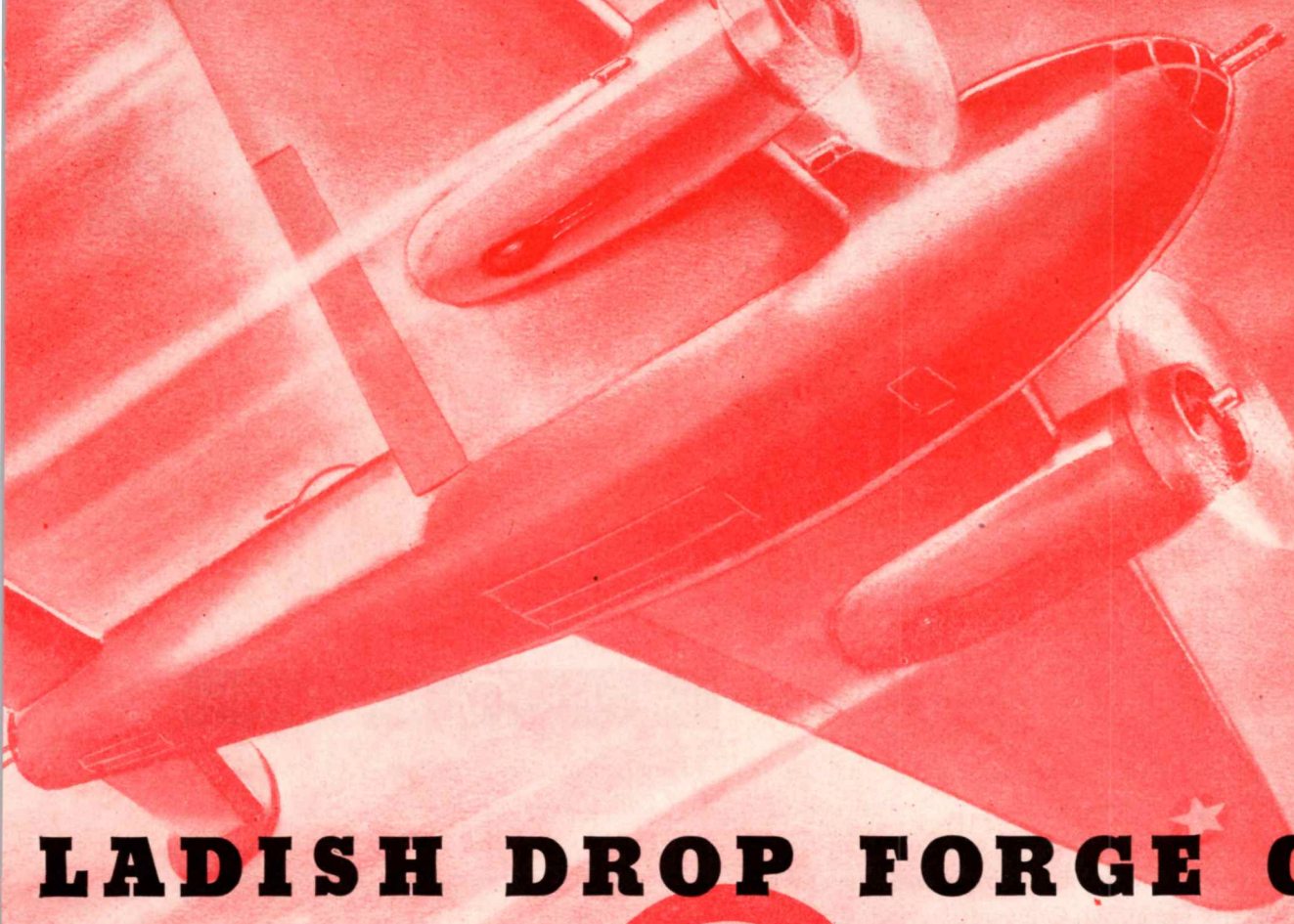
PEREY TURNSTILE CO. *War Plant Division* Architect's Bldg., 40th St., New York

LADISH

quality

DROP FORGINGS

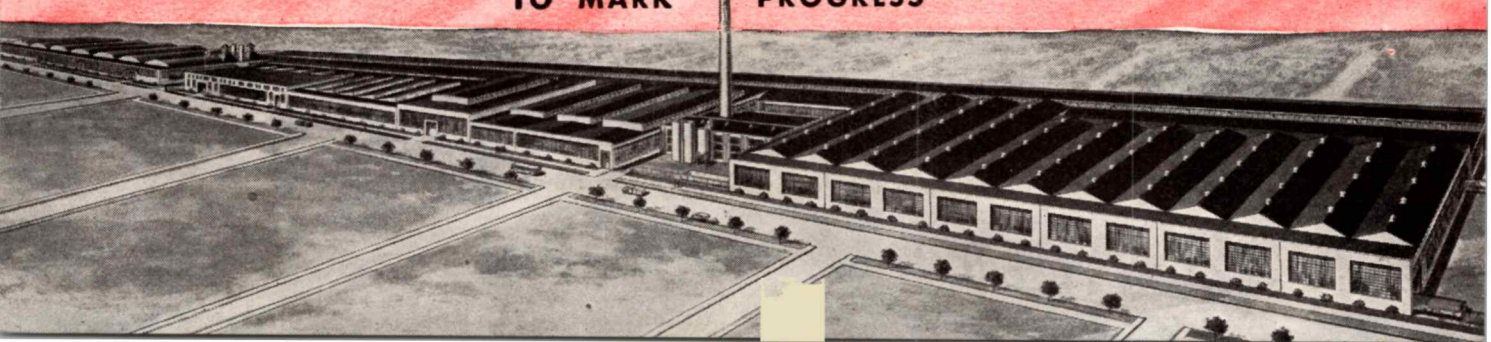
ON EVERY BATTLEFRONT



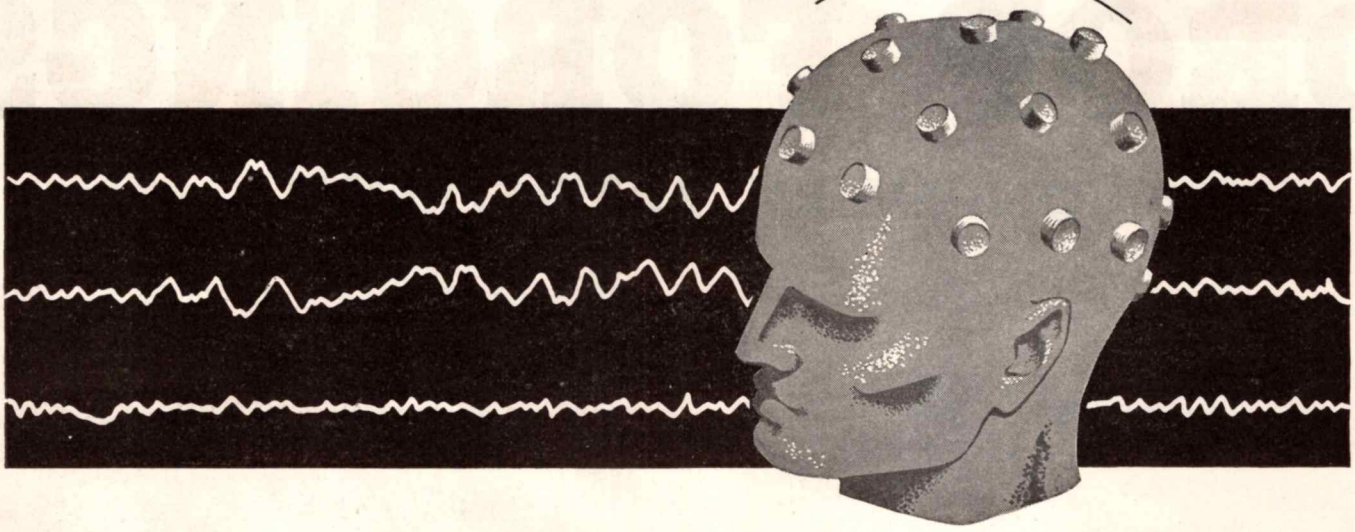
LADISH DROP FORGE CO.

PLANT AND GENERAL OFFICES **CUDAHY . . . WISCONSIN**

TO MARK PROGRESS



TUNING IN ON Brain Tissue



WITH IRC RESISTORS

Scientists have long known that living tissue generates minute electric potentials. But only recently have researchists been able to adapt this knowledge to clinical use on the human brain through means of the Electroencephalograph.

In its functioning, tiny electrodes are fastened to the skin by collodion at the points indicated in the illustration. The average potentials of only 50 microvolts are led to a high-gain amplifier and enlarged to a size where the waves are easily visualized. Comparative studies of the graphs obtained from various brain areas indicate and localize the presence of abnormalities, if any exist.

Quite naturally for such a sensitively adjusted instrument, measuring minute voltages, details of resistor construction are of vital importance in addition to the inherent stability, precision, low noise level and other characteristics which

ANOTHER IRC DEVELOPMENT

are fundamental requirements. IRC is proud to have collaborated in the evolution of the Electroencephalograph and to have had its resistors and specialized engineering skill play a part in its development.

If you are seeking unbiased counsel on a resistance problem, consult IRC—the company that makes resistor units of more types, in more shapes, for more applications than any other manufacturer in the world.

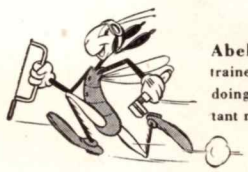
PREFERRED FOR PERFORMANCE
IRC
FIXED & VARIABLE RESISTORS

ARMY E NAVY

INTERNATIONAL RESISTANCE COMPANY

Dept. A · 401 N. Broad Street · Philadelphia 8, Pa.

NOT TOO LITTLE...NOR TOO LATE



Abel Grasshopper . . . trained, seasoned, effective... doing more and more important missions on many fronts.

Overlooked, perhaps in the headline glories of lightning combat planes, and majestic battle-wagons of the air — but the maneuverable, sturdy Grasshoppers are writing new pages of glory with our armed forces. ☆ ☆ ☆ Official communiques emphasize the invaluable job these mighty atoms are doing, such as slipping in with supplies to stranded tank crews...or advance groups cut off from main columns . . . and getting out again from impossible take-offs — with vital information. ☆ ☆ ☆ The Grasshoppers have long established their dependability for instructing in artillery spotting and liaison training at home . . . and recurrent reports from fighting fronts make us modestly proud of the opportunity to emphasize again—and again — Aeronca — "First and Finest". ☆ ☆ ☆ Aeronca Aircraft Corp., Middletown, Ohio.

☆ ☆ ☆

A full-color book to delight the young in heart...Walt Disney's "Mr. Grasshopper Wins His Wings". Send 10¢ in stamps to Dept. **A.** Aeronca Aircraft Corp., Middletown, Ohio.

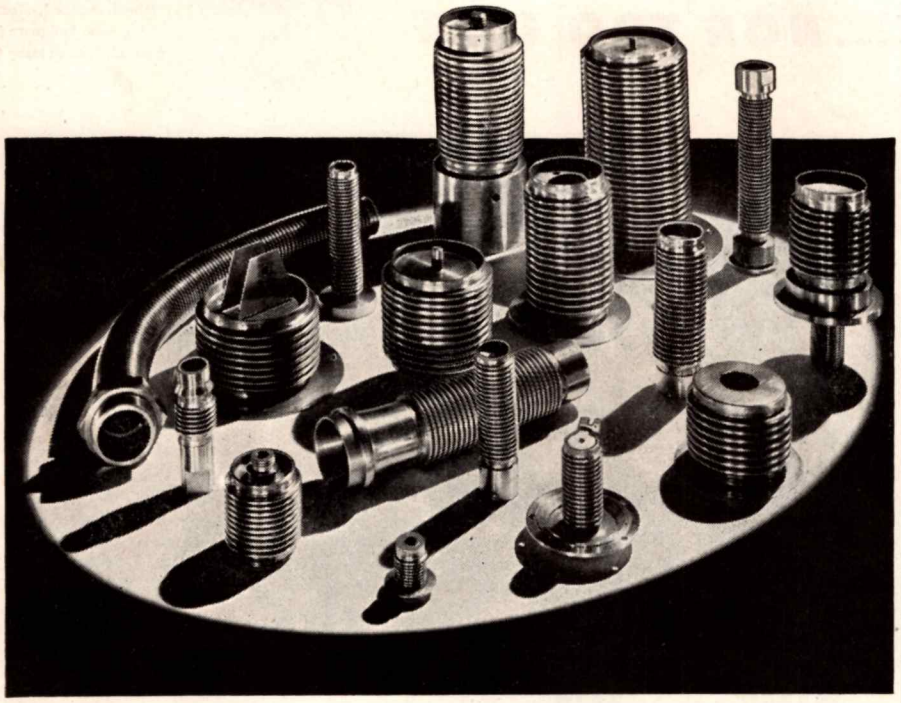
© WALT DISNEY

AERONCA

AERONCA

FIRST *Grasshopper* FINEST

© 1943—Aeronca Aircraft Corporation

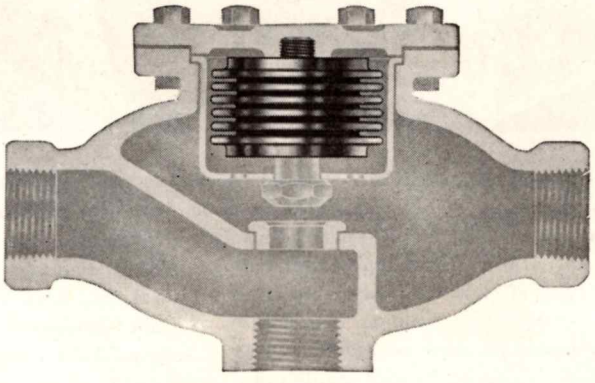


CMH
Stainless Steel Bellows

Wherever stainless steel's corrosion resistant qualities and temperature values are required in bellows service, CMH unimetal **circular seam welded** assemblies are filling that need.

No Solder or Flux Required

Long lengths of CMH Bellows are standard production; strength is further enhanced with **multiple ply** assemblies when needed.



Ask for engineering recommendations on specific applications.

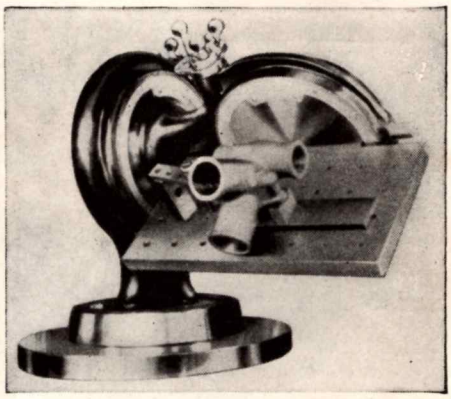
CHICAGO METAL HOSE CORPORATION

General Offices: MAYWOOD, ILLINOIS

Factories: Maywood and Elgin, Illinois

(*Continued from page* 344)

angle or compound angle is calculated or checked by means of dials equipped with verniers. The dials are graduated from 0° to 90° in 4 sections of the circle. The dial recording horizontal rotation is equipped with two verniers while the other dials have one vernier each. All verniers read in 5 min spacing. The frame of the unit is made



of an iron alloy, heat treated before and after the roughing out to minimize warpage or metal distortion. The surface plate is provided with tapped holes for clamping the work into position. Bearing wear is taken up by a heavy spring pressure applied directly to the flanges.

The photograph gives an excellent idea of the computer's flexibility. Certainly the computer should save considerable time as compared with the line bar method.

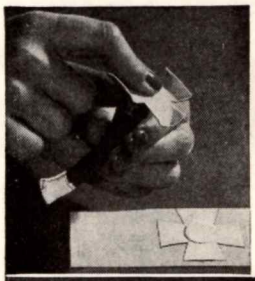
Angle Computer Co., 5720 Melrose Ave., Los Angeles, Calif.

TUBE SEALS

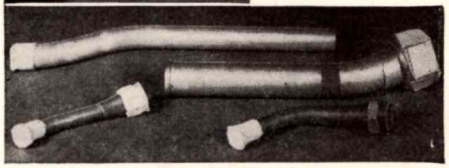
AeroED 2055 (Nov. 1943) . . .

Method for sealing all sizes of tubing.

This seal *No. 700*, is designed and produced for the purpose of closing tube and conduit ends of every description. It is quick, easy, safe, made in a complete range



Arno seals for tube ends are a combination of fibre board discs and adhesive material to hold them in place



of sizes and types of tube ends. No cutting, no waste, no lost motion. The operator with little experience can apply the seals accurately and rapidly and they can be removed quickly without leaving residue.

The adhesive used for this seal is a special formula approved by engineers and pro-

(*Continued on page* 350)

AN IMPROVED SYSTEM FOR CLEANING and TREATING ALUMINUM PISTONS IN VOLUME PRODUCTION

For Uniform Relief of All Internal Stresses

For the cleaning and relieving of stresses in pistons (to eliminate distortion in service) the Mahon system, pictured above, is proving particularly effective.

To remove adhering oil and metallic particles from initial machining operations, racks of pistons first pass through a hot cleaning and rinse unit and then up through a specially designed, gas-fired oven, regulated to a constantly uniform predetermined temperature. Uniformity of oven heat is achieved by continuous re-circulation of an exceedingly large volume of the heated air which completely surrounds and heats each piston *all the way through*—maintaining it at the required temperature for proper processing throughout its oven travel. The system is unusually compact—and entirely automatic—ONE man handling all loading and unloading operations.

Primarily developed for a large manufacturer of aluminum aircraft engine pistons, this practical Mahon system is readily adaptable to any aluminum alloy part or fitting.

Mahon engineers will give you any further particulars you desire and will fully cooperate in working out a similar system suitable to your plant and product.

THE R. C. MAHON COMPANY

DETROIT CHICAGO

Fabricators of Machine Bases and Frames and Many Other Welded Steel Plate Products

Auburn

CERAMIC SPARK PLUG CONNECTORS

a gremlin IN SIZE

a giant IN IMPORTANCE

Only 1 inch long, 1/12th of an ounce in weight, but it packs a powerful punch in Aircraft Engine performance.

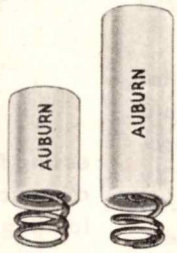
The Auburn Ceramic Connector is a vital unit, assuring constant contact between Ignition Cable and Spark Plug. The Vitreous porcelain sleeve combines high dielectric and heat - resistant qualities. It will not carbonize, carbon-track or absorb moisture. Two sizes serve all applications.

Auburn Connectors have won official approval and acceptance.

Write for complete details.

AIRCRAFT DIVISION
AUBURN SPARK PLUG COMPANY, Inc.
1180 Raymond Blvd. Newark 2, N. J.

ACTUAL SIZE



No. 1041 — 9/16"
No. 1099 — 1"

AUBURN SPARK PLUG COMPANY, Inc.
MAIN OFFICE and FACTORY, AUBURN, N. Y.

(*Continued from page* 348)

duction managers. Discs are of a special hard fibre board, puncture proof with sharp clean-cut edges. Seals come assembled, ready for application and placed on crinoline for convenience in handling.

•

We understand that these seals were developed in cooperation with aircraft engineers. Their shape is that of a Maltese Cross with a fibre disc placed in the center and held firmly by the adhesive mass and it is this construction which makes application so simple.

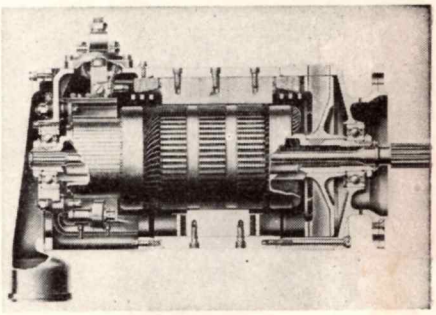
Arno Adhesive Tapes, Inc., Michigan City, Ind

AVIATION GENERATOR

AeroED 2056 (Nov. 1943) . . .

High speed aviation generator which is suitable for both auxiliary and main engine application.

This generator will produce a full rated load of 200 amp at 30 v continuously or 6 KW over a speed range varying from less than 5,000 rpm to 10,000 rpm and deliver three quarters of its rated output at speeds as low as 4,400 rpm. Adequate cooling for both main engine and auxiliary power plant



operation has been provided by means of integral cooling fan and air spout for blast cooling, which permits circulation of air through the hollow armature shaft. A floating type of flexible torque drive shaft is internally splined to the tubular armature shaft at the commutator and of the generator and held in place by a lock ring. An integral drive spline is provided on the drive end of the flexible torque drive shaft which extends through the back head and engages the engine driving member, thereby absorbing engine torsional vibration and compensating for any slight drive misalignment.

The armature shaft is mounted on prelubricated sealed ball bearings which prevent entrance of dirt or foreign matter into the bearings and assure proper lubrication under conditions of blast cooling. Improved commutation and generator efficiency has been obtained by incorporating both interpole and compensating coils which develop auxiliary magnetic fields proportional to the load current and opposed to the magnetic field developed in the armature core by the flow of load current through the armature coils. The interpole and compensating coils prevent armature reaction and reactance voltage from causing destructive sparking at the generator brushes under all load conditions eliminating the need for brush adjustment to prevent sparking at the commutator. Improved brush material has been used to increase brush life under high altitude operating conditions. Weighing only 36

lbs the generator frame measures 12 5/32 in from the alloy steel mounting flange to the back end and is 6 in in dia.

•

The photograph indicates how carefully the generator has been designed and how readily it can be attached to an engine. The design of the unit began with AAF P-2 generator specifications as a basis, but has really advanced beyond the specification. Long range bombers and flying boats may cruise at relatively low speeds. It is therefore an advantage that the generator can deliver ¾ power at only 4,400 rpm.

Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.

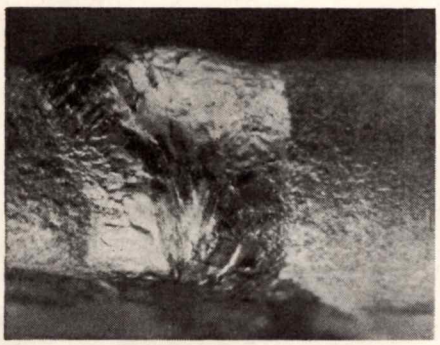
SOLAR FLUX

AeroED 2057 (Nov. 1943) . . .

Flux for welding thin gage stainless steel, etc., without oxidation.

Solar flux #16GH has been developed specifically for the welding of thin gage strips, sheets, tubes, etc., of stainless steel and other high alloy chromium bearing metals. In addition to a melting point, the flux has good adhesive quality desirable for the application to the under side and edges of metal and helps to prevent "burning" (oxidation). No carbon pick-up can result from the flux itself. The flux can also be used to promote metal flow when applied to stainless steel and other high chromium welding rod and can protect rod from oxidation. It may be applied to the metal several hours before the actual welding operation, will hold fast despite frequent handling, and will be found to stick without the use of shellac.

The flux can be used with most welding processes including oxy-acetylene, atomic hydrogen arc, metallic arc and heliarc. While curtailing rejects and repairs, welding speed is not decreased. The flux is available for immediate shipment in 1 lb, 5 lb,



and 25 lb moisture proof containers. Directions for mixing appear on the container labels and the methanol required should be secured by purchaser from his usual source. A companion flux, known as *Solar Flux #16* has been developed, which differs only from *#16GH* in that it has a higher melting point.

•

The new material meets army and navy specifications and is proven well suited for the training in welding of new operators.

Solar Aircraft Co., Dept. SF-4, San Diego 12, Calif.

Industrial dermatitis is as useful to the enemy as a secret agent! It is not through carelessness alone that our new millions of women workers are easier prey to this production-wasting scourge than men have always been. Dermatitis (skin infection) is an occupational hazard—and as such is *preventable*. It is the duty of plant managers to guard against curtailed production by protecting workers' health.

Special hand soaps that help nature maintain a normal, healthy skin condition, protective creams which guard against the effects of specific irritants, and disinfectants that help keep cutting-oils free of harmful bacteria, are examples of West products used in industry to help guard against dermatitis. Hundreds of other West products are designed to fill virtually every demand of modern industry for healthful cleanliness and to protect workers against occupational diseases . . . A West specialist can advise you on this and other problems relating to industrial health.

● *Write for the West booklet "Production Safeguards Against Dermatitis."*

55 BRANCHES · HELPING TO GUARD INDUSTRIAL HEALTH · COAST TO COAST

WEST DISINFECTING Company

42-16 WEST STREET · LONG ISLAND CITY · N. Y. · DEPT. AO

NORTON *Cut-off Wheels* IN AIRPLANE PRODUCTION

In each great bomber pioneering the skies to Victory, hundreds of feet of tubing are used.

Cutting off tubing is an important and sizeable operation in every aircraft plant. Norton Cut-off Wheels are available in a variety of abrasives and bonding processes. Norton abrasive engineers will help you to select your wheel for "wet" or "dry" cutting for the kind of tubing to be cut and for the type of machine on which it is to be used.

Write for booklet No. 517A giving wheel specifications for different kinds of tubing.

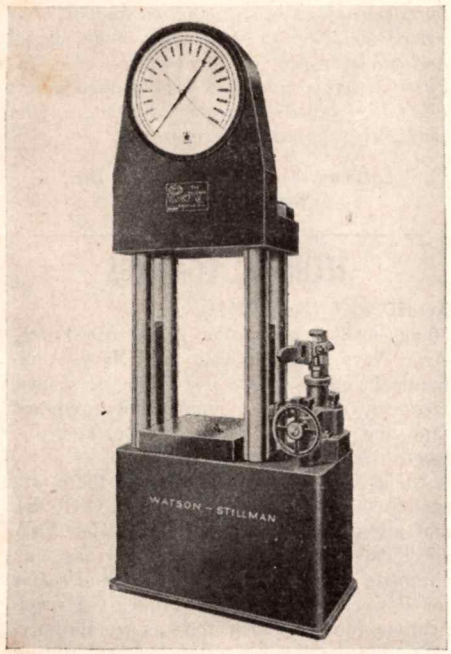
Vital TRADE LITERATURE

Invaluable design and manufacturing information is given in the selected trade literature mentioned on this and following pages. It is available to you for the asking—just fill out the form on page 319. The Editors suggest that you take advantage of this opportunity to secure latest data on vital subjects.

HYDRAULIC LABORATORY PRESSES

AeroED 2058 (Nov. 1943) . . .
5-pg illus bulletin describes a new line of hydraulic laboratory presses and equipment.

The new four-rod machines are useful for testing and experimental work to obtain data needed in process or production problems. They furnish pressures from 10 to 200 tons on comparatively small areas, on die work, straightening or compression tests. The versatility of these presses is indicated by their wide adaptability for die sinking or hobbing, extraction of liquids from vegetable seeds, chemical cakes, fats, briquetting, hot molding, testing concrete and compression and bending tests on various materials. Fitted with electric or steam heated platens, these machines can be used as hand-operated hot



molding presses. Accessories furnished as extras include steam plates, electric heating plates, swivel bearing plates, cage equipment, plate and cloth equipment, filter pads and additional gages.

The testing presses are very handy and compact and meet A.S.T.M. requirements and a complete line of accessories is available. These testing presses would come in handy for tests of relatively small aircraft parts. Other presses should be quite useful in experimental aircraft construction.

Watson-Stillman Co., Roselle, N. J.

INTERSTATE AIRCRAFT

AeroED 2059 (Nov. 1943) . . .
32-pg illus booklet entitled "Interstate—A New Name in Aviation?" tracing the development of a young aircraft concern from its early beginning five years ago, to its present status of turning out planes and parts for the army and navy in quantity.

Though only five years old, *Interstate* is now specializing in the production of training planes and precision units for army and navy aircraft. Among the planes produced are the *L-6*, a liaison and observation for the AAF, the "*Cadet*" used for instruction purposes in many Civilian Pilot Training Schools, and a new twin-engine training plane developed in collaboration with the U. S. Navy. In addition to the production of complete planes, the company also produces such vital parts as bomb shackles, accumulators, machine gun and cannon chargers, gun-sighting mechanisms, and other vital units for the operation, control, and firepower of fighting planes, bombers, and transport ships.

•

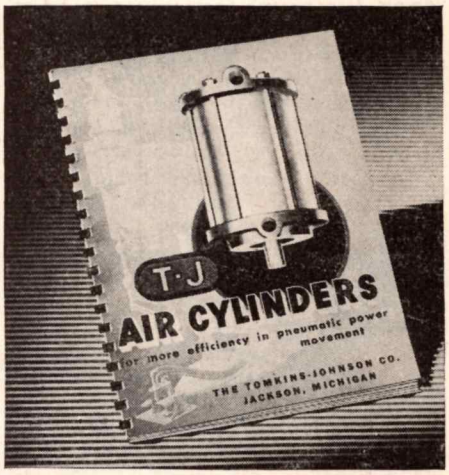
The finely illus pamphlet shows attractive planes and modern functional buildings and is convincing of energetic and sound growth. In particular testing equipment shown is impressive.

Interstate Aircraft & Eng'g. Corp., 3443 Wilshire Blvd., Los Angeles, Calif.

AIR CYLINDER

AeroED 2060 (Nov. 1943) . . .
92-pg illustrated catalogue describes air cylinders used in the airplane industries for more efficiency in pneumatic power movement.

Blueprints and specifications are shown for 112 different air cylinders, included in seven standard styles and also double end rod type cylinders. All of these are non-rotating cylinders, ranging in size from 1½ in dia cylinder bore to 14 in bore. The power (at 80 psi pressure in the stroke out) exerted by these cylinders ranges from 141 lb for the 1½ in bore to 12,315 lb for the 14



in bore. These cylinders are capable of handling power movement in any direction and in any mounting and by consulting the specification charts in the catalogue, cylinders of the exact size and capacity needed can be readily ordered.

•

Pneumatic means are being used increasingly in industry to eliminate complicated mechanical movements, gears, cams, reducing units etc. But such means must be carefully selected, and the pamphlet will be an aid in such selection.

The Tompkins-Johnson Co., Jackson, Mich.

INDUSTRIAL REFRIGERATION

AeroED 2061 (Nov. 1943) . . .
20-pg illus booklet describing air conditioning and industrial refrigeration equipment.

This booklet illustrates and describes a Hermetically-sealed Compressor, and traces its development from the 1932 models up to the present design. It also includes explanations and diagrams concerning the principles of air conditioning, and deals with a complete line of equipment for air conditioning and industrial refrigeration, including models from 1 to 100 hp. In machining work, optical goods grinding and assembly, flying suit

storage, instrument assembly, spot welding, X-ray film developing, capsule manufacture, airfield traffic control, and other industrial processes, the booklet shows how air conditioning and industrial refrigeration may solve production problems. Controlled temperature, humidity, and air cleanliness mean uniform quality, precision, fewer rejections, and faster production.

•

For the busy construction or production man, there is an included chart with three columns, Process, Problem, Solution. We see in this chart instructions of special interest to aviation "Flying Suit Storage. Skins dry out and crack, mildew on furs and fabric. Hold relative humidity at proper level and kill vermin with refrigeration," is a typical item. Others that are specially pertinent are: Instruction in Link Trainers; Parachute Storing; Airfield Traffic Control, etc.

Westinghouse Electric & Mfg. Co., E. Springfield, Mass.

SPOT WELDING ALUMINUM ALLOYS

AeroED 2062 (Nov. 1943) . . .

48-pg illustrated booklet called "Tentative Standards and Recommended Practices and Procedures for Spot Welding Aluminum Alloys."

The booklet is divided into nine sections. Section one deals with standards of weld quality. Illustrations of satisfactory welds and of welds which do not meet specifications are shown. A graph of recommended spot weld shear strength is included as well as discussions on weld metal structure, weld penetration, surface indentation, surface burning and weld spacing and location. Section two gives standards for material preparation, and describes mechanical and chemical means of oxide removal, and methods for surface cleaning. The most common of these methods are presented in table form, the table giving the solutions needed and the time of operation. Section three discusses spot welding technique and shows typical spot welding schedules. Section four lists the methods of testing spot welds.

Among the tests described are the shear pull test, strength consistency test, weld consistency test, weld penetration test, and weld indentation test. Section five deals with inspection of work and section six with the design of good spot welds. In this section are charts of the weldability of the various aluminum alloys, weld spacing, edge clearance and electrode clearance and illustrations of good and bad design of welded joints. Section seven describes the proper use of welding equipment and the installation of welding equipment. Section eight lists the minimum requirements which it is recommended that welders should meet to be able to turn out satisfactory work. Section nine gives elementary rules which should be followed to give maximum production of work. This booklet, which was prepared by the Committee on Aircraft Welding Standards of the American Welding Society in cooperation with the resistance welder manufacturers' association, is priced at $1.00.

•

The Aircraft Welding Standards Committee comprises some of the best engineers and constructors in the aviation industry and it has done a splendid job in these standards which will be invaluable to all those engaged in spot welding airplane parts in aluminum alloy.

American Welding Soc., 33 W. 39th St., New York, N. Y.

RADIOGRAPHY OF MATERIALS

AeroED 2063 (Nov. 1943) . . .

96-pg illus book covering every principle of industrial radiography.

The industrial uses of radiography are not as well known generally as its medical and dental applications mainly because the relatively easier penetration of the human body led to radiography's greater progress in medicine. In the last four years or so the growth of industrial radiography has been almost breathtaking and today radiography is standard practice in hundreds of plants with application to an enormous variety of parts. The book is in reality a splendid text of the technique with excellent chapters covering subjects as follows: X-rays and Gamma Rays; the Radiograph; General Physical Considerations; Intensifying Screens; X-ray Films and Their Uses; Exposure; Processing; Processing Room, Viewing Radiographs; Protection, Unsatisfactory Radiographs. Each chapter is fully illus and highly practical. The book contains definite instruction for operation of such matters as exposures, temperature control, finishing processes and the like. One Appendix gives Bibliography and another Film Characteristic Curves.

○

The book really provides a concise but adequate text covering the basic physical and chemical principle of radiography and its applications, and as such it is recommended for every man concerned seriously with the inspection or control of aviation parts particularly in production and in spots where complication of the part makes visual and other inspection almost impossible. Industrial radiography has been applied as we all know particularly to castings, engine parts, etc., in aircraft generally.

Eastman Kodak Co., X-Ray Div., Rochester, N. Y.

TECHNICAL COATINGS

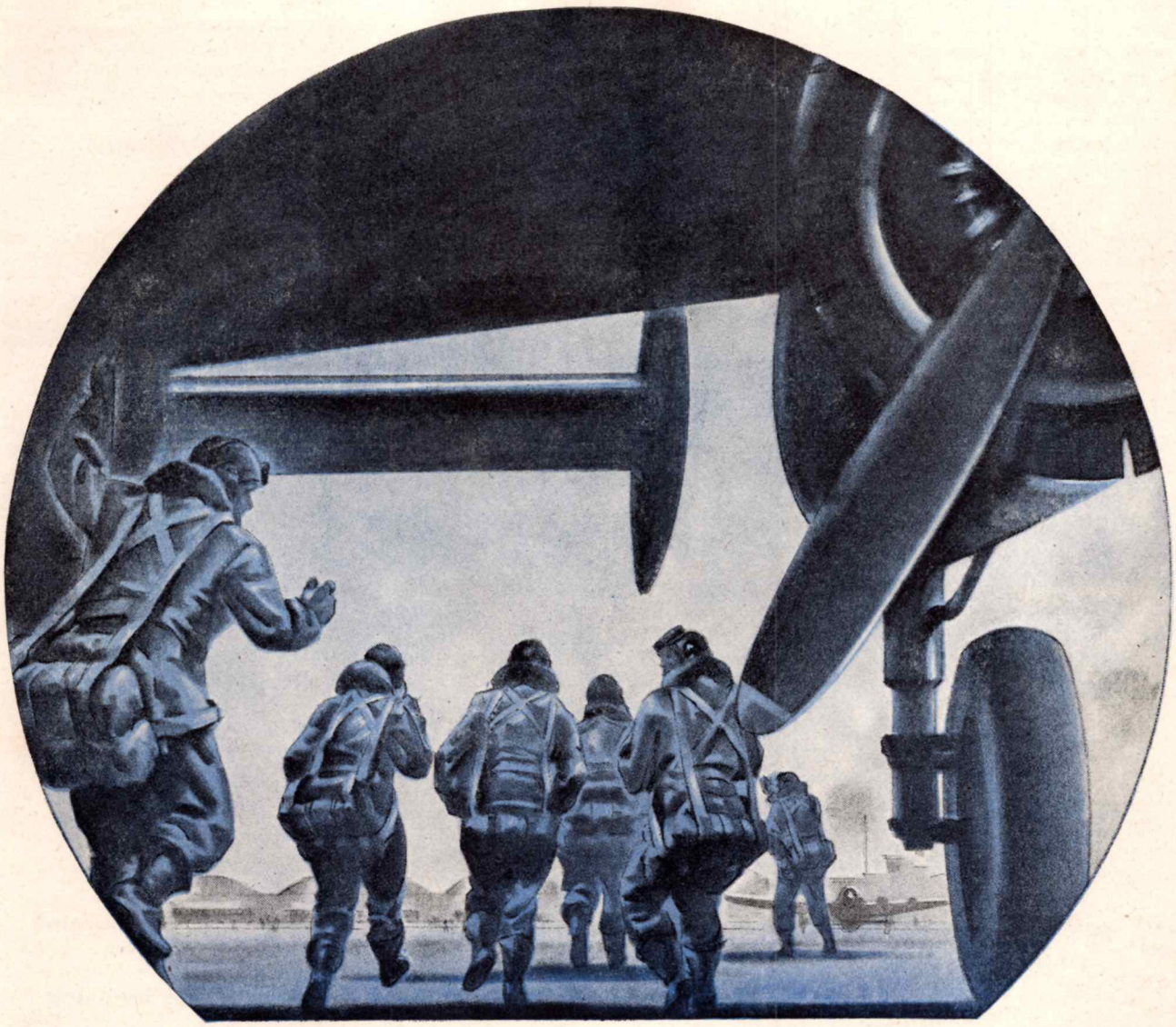
AeroED 2064 (Nov. 1943) . . .

36-pg booklet containing Army Air Force, Army-Navy Aeronautical, and Navy Aeronautical specifications for primers, dopes, lacquers, cements, thinners, and predoped tape and fabric for metal, fabric, and plywood aircraft.

Under the AAF specifications there are such items as camouflage lacquer (14105B) and plywood surfacer (14115); under ANA specifications there are such items as zinc chromate primer (AN-TT-P-656a) and sealer for plywood (AN-S-17); and under NA specifications there are such items as acetate butyrate dope (M-390c) and primer tinting paste (M-542).

For each item, the following specifications are made: purpose, forms, colors, weight, amount applied, thinner, amount of thinner,

(*Continued on page* 357)



"THEY TAKE YOU OUT—AND BRING YOU BACK"

So writes an American pilot from the Southwest Pacific. This statement aptly expresses the finest tribute that can be paid the American combat planes. It is a reflection of the determined and continuous efforts of plane and accessory manufacturers alike to provide ever better performance, greater safety and more dependability. Reports of aerial combat in the various theatres of war show the definite superiority of American planes.

Vickers Hydraulic Equipment is used on the great majority of our country's combat planes because it helps them "take you out—and bring you back."

VICKERS HYDRAULIC EQUIPMENT

VICKERS Incorporated

1458 OAKMAN BLVD. • DETROIT 32, MICHIGAN

Engineers and Builders of Oil Hydraulic Equipment Since 1921

STRENGTH

Photo courtesy of Air Reduction Sales Company

without one ounce of Excess Weight

Present-day designers are thrifty. They constantly seek an ample margin of safety without waste of materials.

More and more, they are gaining this economy of materials by using seamless steel tubing for structural members. Already the universal practice in airplane construction, this use of tubing is rapidly extending into other fields.

Michigan Seamless Tube Company is widely experienced in producing structural tubes for use in many fields. This "know how" is available to the designers of peace time products.

ASK FOR LABORATORY DATA

In supplying tubing for aircraft and other structural requirements, Michigan Seamless Tube Company is thoroughly familiar with the latest developments and projected uses. Our technical staff will make special studies of specific problems on request, without obligation. Write to the company.

BACK THE ATTACK ★ ★ BUY WAR BONDS

MICHIGAN TUBING

ARMY E NAVY

Awarded Feb. 12, 1943

MICHIGAN SEAMLESS TUBE COMPANY

SOUTH LYON • MICHIGAN

(*Continued from page* 354)

application method, drying time, related specifications, and calculations of requirements. At the end of the booklet, there are schematic diagrams listing the various procedures for metal aircraft finishing methods, methods of doping fabric surfaces, methods for low inflammability doping of fabric surfaces, procedures for aircraft plywood, and procedures for fabric-covered plywood. These schematic diagrams are made according to the AAF and NA specifications.

•

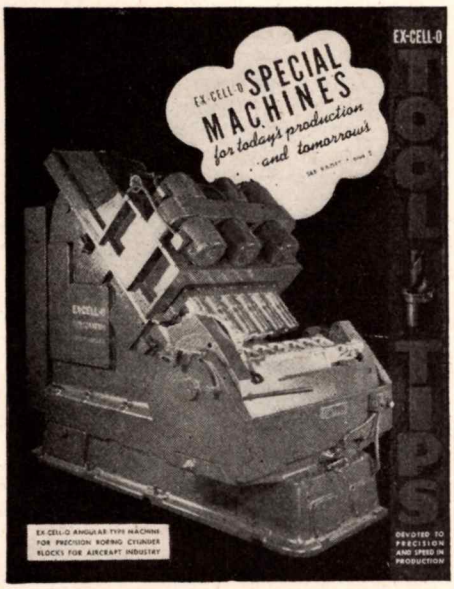
"Pyroxcote" aircraft finishes have been widely used for maintenance and repair in commercial air transport work since 1924. They have now gained an equally enviable reputation in Army and Navy work. Another valuable feature of the booklet is in calculation of specification materials.

Pyroxylin Products Inc., Chicago 32, Ill.

PRODUCTION MACHINES

AeroED 2065 (Nov. 1943) . . .
8-pg, illustrated, booklet describing high speed, precision production machines.

The booklet first describes three styles of thread grinding machines which produce threads in hardened parts with accuracy and finish. The booklet then describes several cutting tool grinders. The importance of a clean, accurate cutting edge is



then discussed. All machines are adequately supplied with coolant to prevent errors due to large temperature changes in the cutting tool. An adjustable work table and protractors permit close duplication of all angles. Several special-purpose machines are also presented which perform many operations simultaneously. For instance, an aircraft crankcase sub-assembly has 448 operations automatically performed on it in a short time by one of these machines. The booklet also illustrates a line of hardened steel pins and bushings now used by many American railroads.

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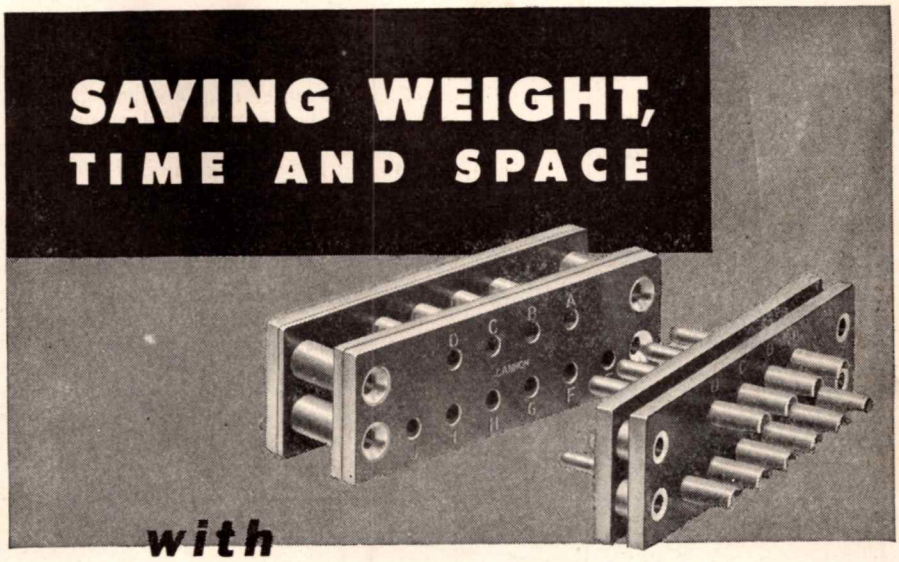
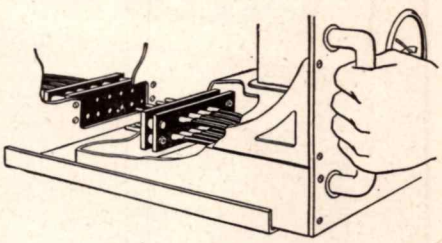
One striking illustration is of a precision machine boring a number of aircraft engine cylinder blocks simultaneously. The tech-



with

CANNON PLUGS

This panel connector is one of the Cannon DP series. It was developed primarily for use on radio and instrument plug-in equipment where weight, space and convenience of operation are often prime considerations.



Both halves of this connector are mounted rigidly. One half mounts on the back of any electrically operated unit. The other half mounts on a rack or panel designed to hold the unit. By this means the excess weight of terminal strips and slack in the cable are eliminated.

In addition to saving weight, Cannon DP Connectors offer many convenient and time-saving advantages in servicing operations.

24 page bulletin with drawings and engineering data on DP connectors available on request. Address Department A-103, Cannon Electric Development Co., Los Angeles 31, California.

CANNON ELECTRIC

CANNON ELECTRIC

Cannon Electric Development Company, Los Angeles 31, Calif.

Canadian Factory and Engineering Office: Cannon Electric Co., Limited, Toronto

REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK

nique of tool grinding is dealt with by a master of the art. Tools of this character have proved invaluable in the aircraft engine industry.

Ex-Cello Corp., 1200 Oakman Blvd., Detroit 6, Mich.

ANTI-FRICTION BEARINGS

AeroED 2066 (Nov. 1943) . . .
32-pg illus booklet entitled "Facts About Anti-Friction Bearings" dealing with the purposes and accomplishments of anti-friction bearings.

The purpose of an anti-friction bearing is to change the sliding friction caused by a radial, thrust, or angular load to rolling friction. In order to perform this task, anti-friction bearings must be accurately finished, and free from foreign matter which might act as an abrasive. Among the various types of anti-friction bearings are the ball bearing, tapered roller bearing, and straight roller bearing.

In the ball bearing category are the following types: single row deep groove used for moderate radial and thrust loads and at high speeds; single row maximum type used for heavy radial loads and moderate thrust loads at moderate speeds; double row used for heavy radial and thrust loads at moderate speeds and having great axial and radial rigidity; singular row angular contact; duplex; self-aligning; thrust bearings; grease plate; felt seal; and snap ring type. In the tapered roller category are the single row type used for heavy radial and heavy thrust loads and moderate speed; flanged cup type used where limited space prohibits cup shoulders; double cup type; and the non-adjustable. For straight roller bearings there are three general classes: square roller, journal roller, and needle roller. These straight roller bearings can take radial loads only, and other provisions must be made to take care of any thrust that is present.

Also included in this booklet is a table giving the equivalent listing of the different types of ball bearings.

•

The booklet is all the better because of its fine illus. which cover terminology, the way in which loads are transmitted and in general give a fine idea of principles.

Ahlberg Bearing Co., 3025 W. 47th St., Chicago 32, Ill.

Courtesy of Vega Aircraft Corp.

• The new worker isn't a stranger to the intricacies of aircraft bending very long — not with a Buffalo Aircraft Type Bending Roll on the job. By means of simple manipulation of easy-working controls, this specially designed Buffalo Bending Roll handles the most difficult bending of arcs, circles and spirals. It's practically automatic! Inexperienced operators are quickly trained, turning our accurately formed stock on a brisk production basis — and with a minimum of fatigue. These tools — embodying all the principal features required by aircraft builders are available in a range of sizes. Data in Bulletin *3344*.

ARMY E NAVY

BUFFALO FORGE COMPANY
165 Mortimer Street Buffalo, New York
CANADIAN BLOWER & FORGE CO., LTD., KITCHENER, ONT.

"Buffalo" AIRCRAFT TYPE **BENDING ROLLS**

METALLIZING CATALOG

AeroED 2067 (Nov. 1943) . . .
40-pg catalog which deals with all phases of the metallizing process.

One section of the book is devoted to the history, development and use of metallizing. A model of a *Mogul* metallizing gun is described and illustrated with complete specifications and engineering data. The accessories which are included in a typical metallizing set-up are also shown. An equipment section describes a new electric bonder for bonding pre-hardened and heat-treated surfaces. This unit provides a positive method of insuring perfect metallizing results on every job and makes it possible to bond bronzes, brass and those metals which do not contain a high percentage of lead. Another piece of equipment described is a unit which simplifies arc welding. Called the *Mogul Link*, it produces a hi-cycle automatic current which serves as a "path" for the regular current produced by the welding machine. This path allows the welding current to flow much more smoothly and without interruption. The welder will weld with any welding rod, coated or bare, steel or alloy rods. One section of the catalog is devoted to questions and answers pertaining to metallizing and another gives an extensive list of metallizing applications.

•

The booklet is a remarkably complete manual of the metallizing art and covers every problem in production, maintenance and corrosion prevention.

Metallizing Co. of America, 1330 W. Congress St., Chicago, Ill.

ULTRA HIGH FREQUENCIES REFERENCE GUIDE

AeroED 2068 (Nov. 1943) . . .
56-pg book titled "Trail Blazers to Radionics and Reference Guide to Ultra High Frequencies" with a bibliography of existing literature in this field of radio transmission and reception.

The book is divided into two sections. Part one contains brief biographical sketches of the men of science who have contributed to the development of radionics in all of its branches. Among those mentioned are Andre Ampere, Thomas Edison, Roger Bacon, Marie Curie, Albert Einstein, Gustav Kirchhoff

and George Ohm. Following each of these biographies is a list of references where more detailed information may be found. Part two contains a short introduction in which U.H.F. technique is discussed. This is followed by a list of authors and books on the subject, the latter being arranged alphabetically. The remainder of the book contains references which are divided into several categories namely, antennas, wave propagation, generators, receivers, measurements, U.H.F. in aviation, U.H.F. tubes, crystals, and miscellaneous articles on ultra high frequency, and a bibliography of frequency modulation.

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Many physical differences separate "ultra high frequency" technique from that of "standard radio." Oscillator, transmitter and receiver circuits are similar to those with which engineers are quite familiar, but the components required to build u.h.f. equipment have changed and are changing rapidly. In fact research progress is so rapid that it is difficult to keep completely up-to-date. This splendid bibliography is up-to-date and will be welcomed by serious research workers in this field.

Zenith Radio Corp., 680 N. Michigan Ave., Chicago, 11, Ill.

INJECTION MOLDED AND EXTRUDED PLASTICS

AeroED 2069 (Nov. 1943) . . .
40-pg book illustrated in color describing the manufacture, properties and application of plastic products, under the above title.

The pamphlet describes the method of injecting molding. Thermoplastic material is fed into a hopper surmounting the injection molding press, automatically, into a heating chamber in correct proportions. It is heated to a plastic condition and forced through a nozzle inserted in the extreme end of the heating chamber, into a passage or sprue, then through runners (or troughs) into the various mold cavities where it solidifies and is ejected when the mold opens. The operation is immediately repeated. The molds are made very accurately and the products are accurate accordingly.

Since plastics can be made of very beautiful colors, many eye-pleasing products can be obtained. Some of these include pipes, broom shoulders, dial housings, lamp stands etc. The latter part of the book is devoted to a description of plastic tubing. This is a most practical product because of its adaptability under high bursting and working pressures, insulating qualities, resistance to most chemicals, flexibility and ease of handling. It has been especially practical in a multitude of applications previously demanding such vital materials as aluminum, brass, copper, nickel and stainless steel. The toughness and abrasion resistance of this tubing assures long life under rough usage, eliminating costly replacements. It is particularly resilient, permitting use under conditions subject to repeated vibration. Specifications as to size, weight, and working pressure of these tubes are also listed.

•

The index to what constitutes a text on plastic practice is particularly well arranged. It first takes up engineering and designing, tool room, molding room etc. Then lists plastic material data (which includes tables of properties). Then classifies thermoplastic materials by their appropriate chemical designations and classifies them by trade names.

Elmer E. Mills Corp., 812 W. Van Buren St., Chicago, Ill.

AIRPLANE TIRES

AeroED 2070 (Nov. 1943) . . .
12-pg illus catalogue describes various types of airplane tires and the tests performed on the tires.

It reviews various tests the tires go through such as; (1) the test in the "torture chamber" laboratory, where the extra margins of safety and toughness are measured; (2) the test whereby water under high pressure is put into the tire until it bursts and a dial records accurately the operating factor of safety for each tire type; (3) the life of the tire is determined in a few hours by revolving the tire against a rough surface at high speeds; (4) the test of relative conductivity of the tire, and (5) getting the load deflection and contact area for all types and sizes of tires.

The catalogue also describes low and high pressure tires. The low pressure tire meets the needs for extra cushioning, and extra strength demanded for airplane landings. The high pressure tire is smaller and lighter than the low pressure type and is used for

(*Continued on page* 361)

The Signal Corps does it again . . .

Greater EFFICIENCY!

The Newest Development in Military Headsets!

THIS new headset was designed to fit under the new helmet that protects the soldier's head and neck. A small soft plug fits into the ear, providing a more effective seal against outside noises. Because the plug type earpiece focuses the sound directly into the ear, these new receivers have a tremendously higher fidelity of response. The inserts are made of neoprene, thus requiring almost no strategic material. Now a complete, all-purpose headset may be issued to each telephone and radio operator individually.

Consolidated Radio's modern mass production methods can supply signal corps and other headphone units in quantities to contractors.

Electronic and Magnetic Devices

CONSOLIDATED RADIO Products Company

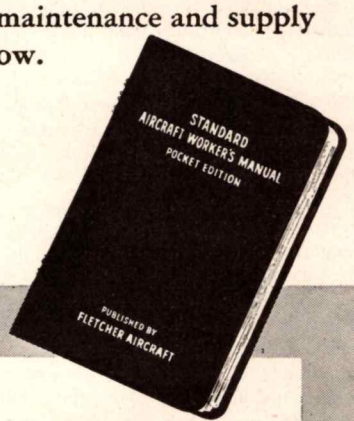
350 W. ERIE ST., CHICAGO 10, ILL.

BURBANK TO BURMA

IN ALMOST every corner of the world today are men who got their start in aviation through Fletcher Aircraft training. They are at every front and in the factories across America. Fletcher is proud to have shared in their record.

After Victory Fletcher will again start out more men for Boston, Burma and beyond with complete lines of materials and accessories to service and supply the air commerce of the world. Years of experience in training men . . . plus wartime experience in reconditioning planes is building up this maintenance and supply organization that will be ready tomorrow.

Fletcher Aircraft
BURBANK, CALIFORNIA



Backbone of Fletcher training is the famous Standard Aircraft Workers Manual. More than 150,000 copies are now in use by all prime plane manufacturers and by many technical schools and colleges. The new 7th Edition contains all vital information on metals, AC-AN and B standard parts and tools used in aircraft production. Get your copy of this vital book. Mail the coupon today.

Fletcher Aircraft
Burbank, California

Please send postpaid the new 7th Edition of the Standard Aircraft Workers Manual for which I enclose $1.50.

Name_____

Address_____

(*Continued from page* 359)
extra high-load carrying capacity per pound of tire and tube weight, where a smooth landing surface is available. Also available are smooth contour and auxiliary wheel tires. Charts give all sizes, types, dimensions, weights, and capacities of the low and high pressure landing and auxiliary wheel tires in both the non-skid and smooth types, as well as giving load and inflation tables for each tire.

•

The pamphlet contains perhaps the most complete data published on a subject which is of vital importance to airplane builders.

B. F. Goodrich Co., Akron, Ohio

SPECIFICATIONS FOR PLYWOOD AND ADHESIVES

AeroED 2071 (Nov. 1943) . . .

17-pg detailed bulletin entitled *Government Specifications for Plywood and Adhesives* reviews specifications for veneer, plywood and glues.

The bulletin describes the four basic specifications that are widely recognized and from which most government specifications are developed, with modification to meet special requirements. These basic specifications are: *AN-G-8, Cold-Setting Resin Glue; AN-NN-P-511b, Plywood and Veneer; Aircraft Flat Panel; CS-35-42, Plywood (Hardwood and Eastern Red Cedar) and CS-45-42, Douglas Fir Plywood.* The method of treatment adopted in the bulletin is to give designation and title of each, followed by a brief description of its adhesive requirements. Some of the departmental specifications described are Application of Cold Setting Resin, Fluid Pressure Molding, Packaging and Packing requirements for overseas shipment, cargo bodies, planking, panels, etc. Test procedures are outlined and related to the basic specifications and where the tests differ from those given in the basic specifications, they are briefly described. The adhesive which best meets this requirement is recommended.

•

Plywood has come to play a permanent and important part in the construction of airplanes and gliders, but its correct use and the correct use of adhesives is more difficult in many respects than fabrication in metal. A handy compilation of these specifications is all the more valuable.

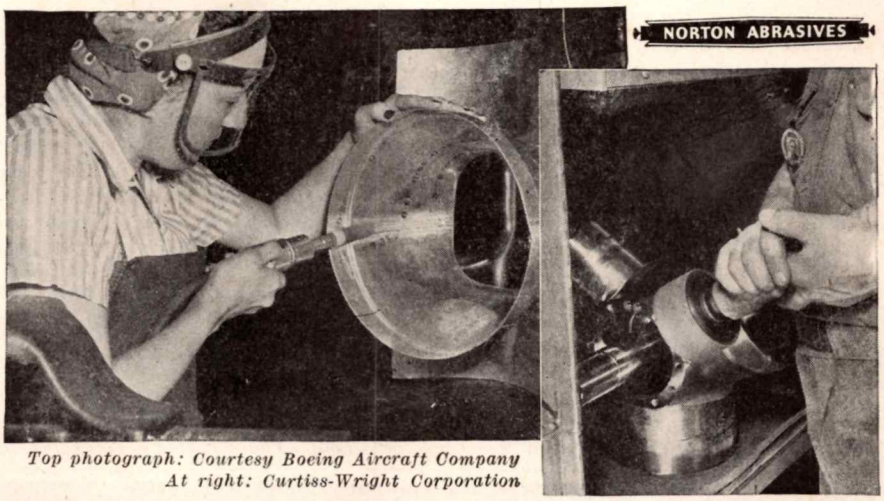
Resinous Products & Chemical Co., Washington Sq., Phila., Pa.

AIR-OPERATED DEVICES

AeroED 2072 (Nov. 1943) . . .

24-pg illus catalog describing a complete line of air operated devices, under the title *Illustrated Air Power.*

One important device described in the catalog is a novel design of an air clamp. The air clamp consists of an air cylinder universally mounted on the column of a drill press in such a way that it can be quickly locked in position to apply pressure to any piece of work so that a machining operation can be performed on the work. The locking is done by simple hand levers and no



Top photograph: Courtesy Boeing Aircraft Company
At right: Curtiss-Wright Corporation

NORTON ABRASIVES

Saving TIME, MONEY— *Possibly* LIVES

YOU'LL BE ASTONISHED at the speed and economy with which these Metalite Cloth "Gadgets" do slow, costly little metal finishing jobs. The accuracy of finish or radius produced by them on many vital parts also contributes to the eventual performance and safety of the whole.

Honestly, now, have you fully explored what these many little abrasive cloth forms can do for you right on tools now in use in your plant? Have you had a Behr-Manning Field Engineer show you all the shapes and sizes — even demonstrate them on the jobs you select?

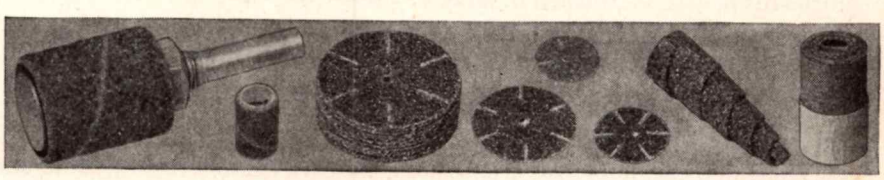
Concerns such as those who supplied our illustrations have made great savings by adopting "Gadgets" as the principal means of doing the most irritating kind of finishing operations —irritating because the time consumed formerly was so out of proportion to their size.

Write direct to Troy or our nearest Branch for the services of one of our able Field Engineers.

Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Grand Rapids, High Point, Indianapolis, Los Angeles, New York, Philadelphia, St. Louis, San Francisco, Tacoma.

BEHR-MANNING · TROY, N. Y.

(DIVISION OF NORTON COMPANY)



wrenches are required. Certain advantages of the air clamp over other work holding methods appear at once. It is always on the drill press ready for immediate use; no time is lost looking for loose clamps or, when found, trying to make them apply pressure in the right spot in the right direction.

Vibration does not shake an air clamp loose; variations in size, a frequent source of trouble with rough castings, do not affect it; it holds with equal pressure at any point along its stroke. Skillful hands are freed to undertake additional productive work; in the tool room by reason of simpler jigs and fixtures; at the drill press by virtue of faster work handling and less consumption of muscular effort. Another item described in the catalog is a work feeder. These units are excellent for handling large numbers of small parts. The units feed the part into the machine for the necessary operation and then eject it. The catalog also describes "Supercharger Jaws" which are designed to overcome the high torque involved in tapping small cylindrical pieces. These jaws are self-centering and do not need high line pressures. Other items in the catalog include foot controls and valves to regulate the flow of air.

•

The illustrations in the catalog appear to justify the descriptive claims made for the air clamp. The air clamp holds the piece to be operated on so easily and so powerfully, and without interfering in any way with the actual operation of the machine tool itself. While designed for live pressures of 40 to 100 psi, the clamp itself produces a pressure four times as great.

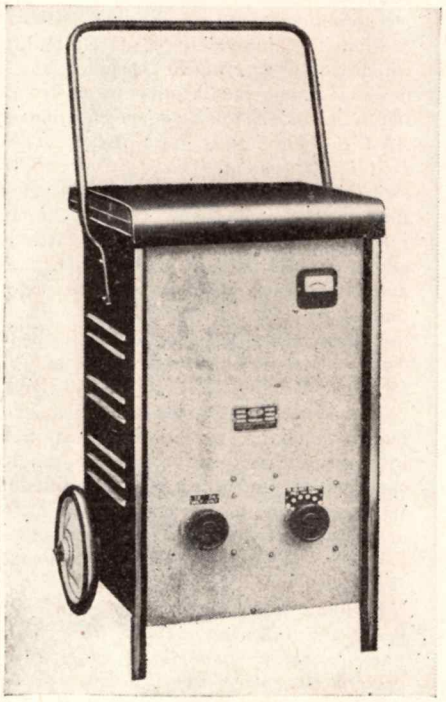
Mead Specialties Co., 15 S. Market St., Chicago 6, Ill.

ELECTRICAL RECTIFIERS

AeroED 2073 (Nov. 1943) . . .

Two illustrated catalog sheets describing stationary and portable rectifiers.

For high ratings, a model known as the *H series* industrial rectifier, with a capacity up to 4000 dc is recommended. The dc output is adjusted by a regulating knob which operates a rotary tap switch connected in the primary circuit. The rectification is three phase which makes the output suitable for operating dc motors and relays. Thermal protection is provided against overload and overheating. A simple



ventilating system is cooled by a fan motor which requires no starting mechanism. Special designs are available with dual voltage control allowing the output voltage to be cut in half, the amperage to be doubled.

The rectifying element is made of magnesium-copper sulphide and is capable of withstanding shocks, vibrations and momentary overloads. The dimensions of this unit are approximately 16 in by 16 in by 29 in. They are available with output voltages ranging from 12 v to 48 v. For smaller capacities the *M series* rectifier is suitable. It has a capacity of up to 1500 w and is made in both stationary and portable models. A solid overhanging top offers good protection for outdoor use. Its overall size is approximately 13 in by 13 in by 19 in. In other respects it is constructed like the *H series* models with voltages available from 12 v to 32 v. For battery charging, signaling equipment and solenoids the *L series* rec-

20/20 VISION . . . HE STILL NEEDS Ray-Bans

Poised for his leap into space, this paratrooper knows the full comfort Ray-Ban sun glasses give keen eyes.

With eyes protected against the blinding dazzle of the desert sun, he quickly sees a safe landing spot and works his parachute toward it. Hours spent on blistering desert sands do not burn his eyes—behind their cool, comfortable Ray-Ban lenses.

That's why Ray-Ban sun glasses are sold out to the Army and Navy today—why Ray-Ban lenses are available to civilians *only on prescription.*

BAUSCH & LOMB
OPTICAL CO. ROCHESTER, N. Y.
ESTABLISHED 1853

AN AMERICAN SCIENTIFIC INSTITUTION PRODUCING OPTICAL GLASS AND INSTRUMENTS FOR MILITARY USE, EDUCATION, RESEARCH, INDUSTRY AND EYESIGHT CORRECTION

tifiers with up to 175 w output and approximate dimensions of 9¾ in by 11½ in by 11 in high is recommended. This unit is made in outputs of from 24 to 72 v. The various models are listed with their respective capacities and prices.

•

These rectifiers are well adapted to give dc current from ac terminals in aircraft testing, engine testing, battery charging and similar duties. They appear to have low stand-by losses and low maintenance costs.

McColpin-Christie Corp., Ltd., 4920 S. Figueroa St. Los Angeles, Calif.

HINTS ON POLISHING

AeroED 2074 (Nov. 1943) . . .
An illus handbook entitled *Felt Wheels and Bobs* to help speed industrial polishing jobs.

Among the many features contained in this book is a detailed outline of the proper way to set up polishing wheels. Another

section is devoted to the care and maintenance of felt bobs and wheels with each step illustrated for easy reading.

•

Information is also given on felt, rouges, steel wool, and other related products used in metal finishing. The handbook is timely as manufacturers and plating shops take on more inexperienced help.

J. H. Rhodes Co., 157 Hubbard St., Chicago, Ill.

DESIGN-STRENGTHENED MATERIALS

AeroED 2075 (Nov. 1943) . . .
20-pg illustrated booklet describing a new process for obtaining higher strength-weight and higher rigidity-weight ratios from materials used in aircraft frame-work.

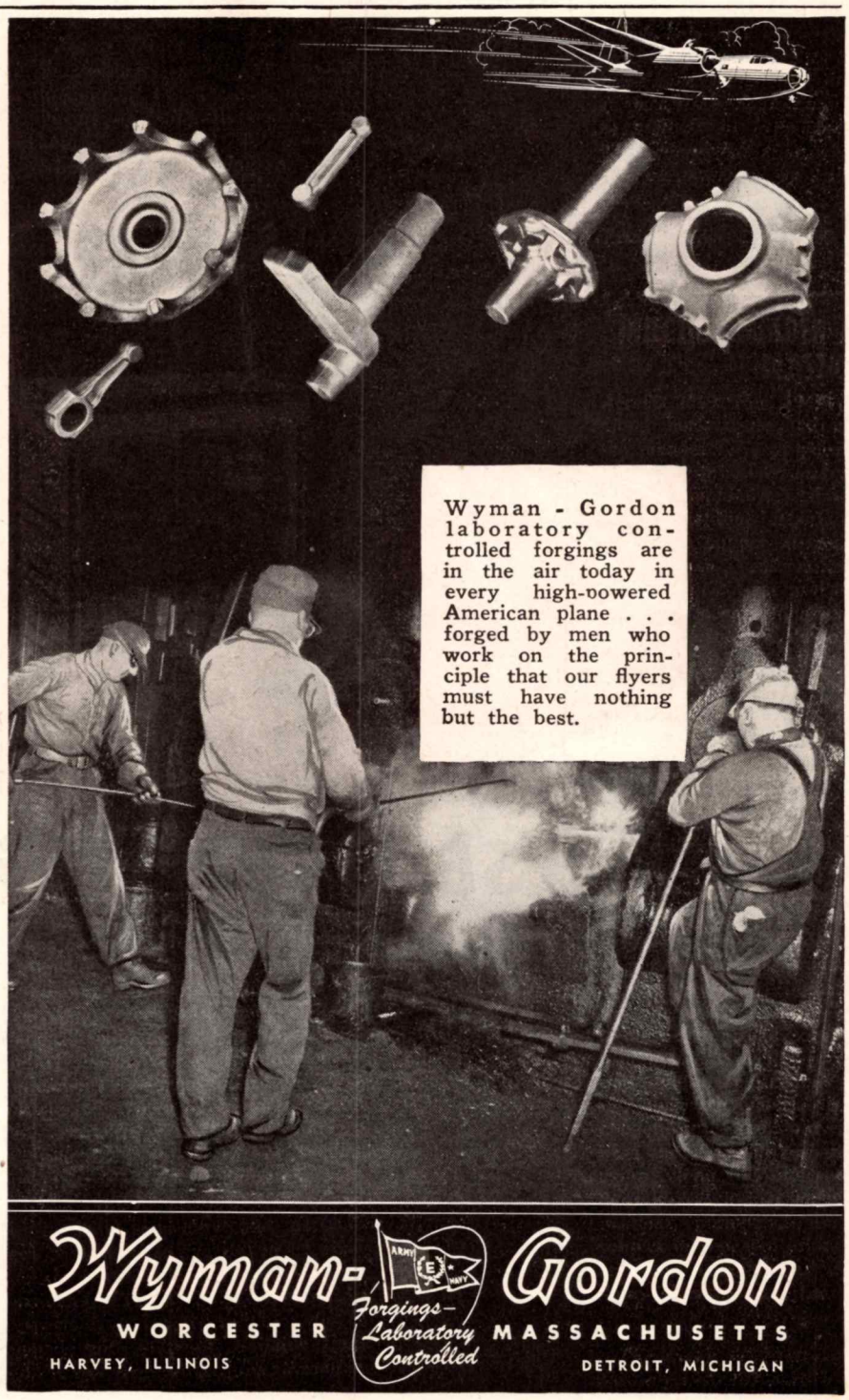
A common method of strengthening material by forming it is through corrugation. A tremendous increase of buckling strength for carrying axial loads parallel to the corrugations can be obtained with increased rigidity and strength for carrying transverse loads. The booklet points out, however, that corrugation has the following inherent disadvantages: The strength of the sheet is increased in only one direction—parallel to the corrugations. Buckling strength and stiffness perpendicular to the corrugations are decreased.

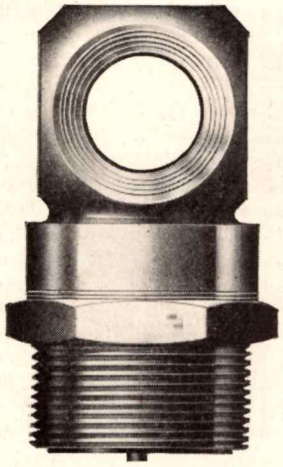
Weight per unit of projected area is greater for the corrugated area than for the flat sheet and workability of the corrugated sheet is limited. On the other hand, by a process whereby parallel depressed wavy lines form lozenge-shaped opposing waves in the sheet, directional strength as it is called gives strength in one direction with no loss of strength in the perpendicular direction, or it can be applied in two or more directions perpendicularly to one another, or even in all directions by alternating concave convex design patterns. Very careful investigation has been made of various specimens in tensile, buckling, flexural rigidity. These tests were made on stainless steel, carbon steel and aluminum alloy. There seems little doubt that the test conclusions indicate great additional strength in column patterns and in flexural stability.

•

The tests and other information was recently presented in a paper before the Institute of the Aeronautical Sciences in confirmation of the above views. A very desirable process seems to be available for strengthening metals mainly in use in aircraft construction. Applications in structural and non-structural and moulded parts are almost as great as the number of such parts made of metal in the airplane. The booklet

(*Continued on page* 365)





A·S·P

PRESENTS

A NEW SELF-SEALING COUPLING

FOR HYDRAULIC AIRCRAFT UNITS

A disconnecting, self-sealing coupling that really works. One prominent aircraft manufacturer writes that he has "found that this coupling is of much sturdier construction and more fool-proof design than present equipment. The American Screw Products coupling has consistently withstood 2500 p.s.i. with only finger-tightening. A sample coupling purposely crush-tightened with a long-handled wrench did not leak upon disconnection, or reassembly. The hydraulics section of Engineering has granted unqualified approval of this coupling."

These features are important: Heavier construction of the high-strength aluminum body prevents distortion under very severe handling conditions; jamming of spring-loaded shut-off valve is prevented. Light weight cast phenolic poppets are positive-sealing in action. Springs are made of finest heat-treated steel. Synthetic gasket provides leak-proof connection when coupled for service. Available with AC or AN threads. Write for full details and prices.

AMERICAN SCREW PRODUCTS

7000 AVALON BOULEVARD • LOS ANGELES • CALIFORNIA

(*Continued from page 363*)

contains authentic diagrams and we recommend its reading to every structural analyst and aircraft designer.

Rigid-Tex Corp., 658 Ohio St., Buffalo 3, N. Y.

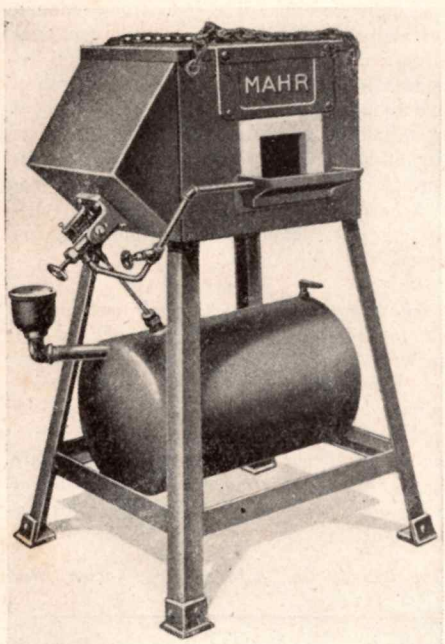
RIVET HEATERS

AeroED 2076 (Nov. 1943) . . .

8-pg illus bulletin showing various types of gas and oil fired rivet heaters.

Included in the models listed are low pressure oil burning heaters, both portable and stationary, vacuum type heaters, and light weight heaters for use of scaffolds. In the low pressure heaters, blowers provide air at a pressure of 12 oz to the atomizing burner which mixes it with the proper amount of fuel. The low pressure air makes adjustment of the burner easier and also preserves the fire brick in the heat chamber, adding from 33% to 50% to its wear life.

The portable units have electric plug-in for blower and oil pump and carry a 20 gal oil tank. The vacuum heaters use compressed air at 80-100 lb to create a vacuum which draws oil from the tank to the burner where it is mixed with air in a chamber, atomized, and sprayed into the combustion chamber. Light weight units operate in the same manner as do the heavier heaters but have smaller rivet capacities. Their weights range from 165 lb to 260 lb with overall heights from 41½ in to 57 in. The large models weigh from 555 lb to 1135 lb. Complete specification data of sizes, burnering, fuel consumption and other pertinent information is given for each heater model. Several types of burners are also included in the catalog as is lining tile for the rivet heaters.



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When a rivet goes to the riveter it should be clean and thoroughly and uniformly soaked with heat. Only then will perfect riveting be possible. It is important therefore to select heating equipment with the greatest possible care. The equipment described has proved itself thoroughly in a number of heavy industries.

Mahr Mfg. Co., Div., Diamond Iron Works, Inc., M.nneapolis, Minn.

PLASTIC MOLDED PARTS

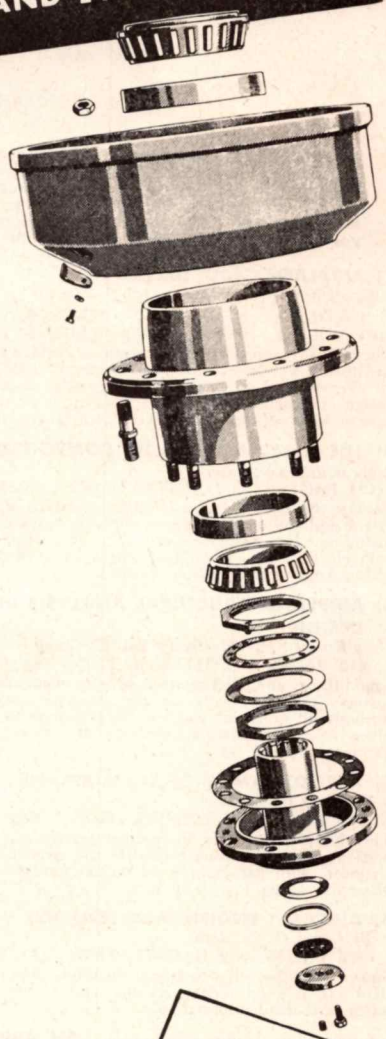
AeroED 2077 (Nov. 1943) . . .

8-pg illus booklet describing the activities of an important plastics department under the title *Designing Molded Plastic Parts.*

Information from the engineering files of the Plastics Department includes such topics as: size and shape of inserts, wall thicknesses, tolerances, shrinkages, holes and undercuts, ribs, bosses, and fillets. The first topic discussed is inserts in molded plastic parts and general instructions are given for designing four different types of inserts; rod and wire, threaded, spun over, and stamped or punched. The instructions include suggestions as to size, shape, type, and location of the inserts. The next topic discussed is wall thicknesses. Minimum wall thicknesses between holes and in other locations are given. In general, minimum wall thickness is determined by the area to be covered and the maximum distance the material must flow.

The booklet then discusses tolerances and the factors on which they depend. Some of these factors are: directions of dimension (whether normal or parallel to parting plane), type of compound, method of molding, and general shape of product. Grinding or machining is sometimes the most economical method of obtaining close dimensional

CRAFTINT SPEEDS PRODUCTION OF HANDBOOKS AND MANUALS



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accuracy. Another important topic is shrinkage. The three main factors which influence shrinkage are: type of compound, part design (uniformity of sections, etc.), and conditions of operation (use in liquids, high temperatures, etc.). The booklet gives hints for good design to prevent warping and cracking. Permissible sizes of holes and undercuts and the rules for their design are then dealt with. Finally, the need for ribs, bosses, and fillets is taken up and recommended shapes and tapers for ribs are given. Ribs should be used to support large, otherwise unsupported surfaces. They also facilitate flow of material. Bosses are used for mounting or assembly and should be located in corners when possible. When four bosses are used, they must be ground flat and three bosses are preferable as they do not require this operation. Fillets are needed at the base of ribs or bosses. They facilitate the flow of the compound and reduce stress concentrations. Minimum sizes of fillets are given.

•

This engineering test, as it may well be called, is not intended to cover primary structures, but it does cover the field of injection molded parts that are so numerous in the airplane. The practical hints for design are illustrated with dimensional sketches, and typical applications such as an electrical contact support. The pamphlet becomes necessary reference material for every airplane design engineer.

General Electric Co., Pittsfield, Mass.

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AIRCRAFT MOTORS

AeroED 2078 (Nov. 1943) . . .

24-pg bulletin (No. 120) containing illustrations and specifications for a series of aircraft motors.

Dimensioned drawings for each model are included as well as possible modifications of the unit and typical applications. Horsepower outputs ranging from 1/50 to ¼ hp are available in the direct drive motors which weigh from 1.44 lb to 7 lb 8 oz. One of these motors, type *A2X* is especially designed for service in atmospheres where hazardous gases and dusts may be present. A ruggedly constructed housing prevents the propagation of flame outside the motor should an accumulation of gas within the motor explode. It is series wound and rated for continuous service, weighs 2.8 lb, gives a 1/20 hp output at full-load rpm of 7500 and has a torque of .42 pound-inches.

Units containing reduction gears are also available with eight gear ratios. All the motors are built to function dependably in the rarefied atmosphere of high altitudes as well as under desert conditions. These units are light and compact but strong enough to withstand severe shock and continual vibration. Armatures are statically and dynamically balanced to eliminate vibration and both armatures and fields are subjected to a 5000 v flash test for grounds. Housings are of aluminum precisely machined to insure accurate bearing alignment. The motors have the characteristics of a high starting torque, quick acceleration, varying speed, and high speed.

•

These motors are particularly well adapted to aviation service, under the widely varying conditions which are encountered in combat aviation. Thus they are self-lubricating at all temperatures down to —75° F and carbon brushes are designed for maximum service at high altitudes. They are giving excellent service in the actuation of wing flaps, cowl flaps, oil cooler flaps, intercooler door, etc.

The Dumore Co., Aviation Div., Racine, Wis.

CONNECTICUT DEVELOPMENT COMMISSION

AeroED 2079 (Nov. 1943) . . .

A handsomely illus booklet *Connecticut . . . Center of Aviation.*

The booklet, written and published by the Connecticut State Development Commission records Connecticut's pioneering in aviation, its present leadership in this field, and forecasts what the industry's future expansion offers to this State. Connecticut's reservoir of skilled mechanics trained in precision manufacturing practices is rightly stressed as an asset.

•

There is little doubt that Connecticut has earned for itself a splendid place in the aviation field, which it intends to maintain. The booklet should be of interest to manufacturers.

State of Connecticut, Development Commission, State Office Bldg., Hartford, Conn.

DON'T LET BUGS GROUND 'EM!

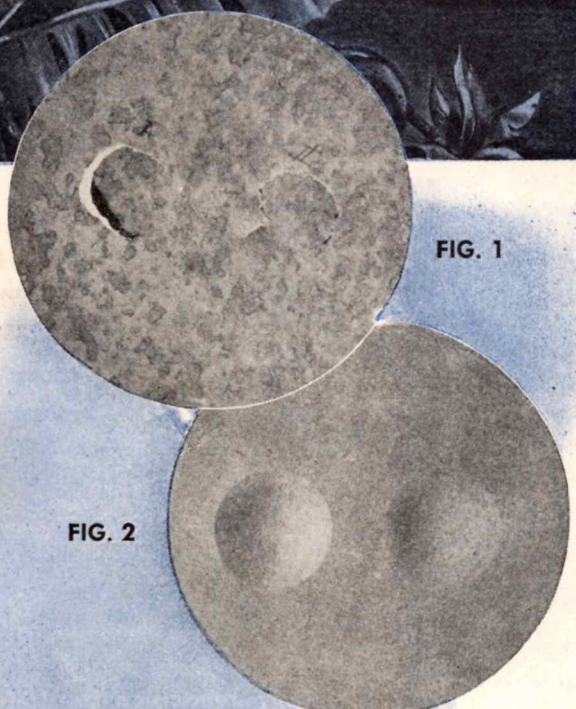

FIG. 1

FIG. 2

BURIED IN MILDEW INFESTED EARTH FOR 30 DAYS

Fabrics finished with conventional 7 to 12 coat dope systems lose approximately 60% of their original strength following attack by mildew organisms. (Fig. #1). Fabrics finished with the 4 coat EMYCEL system and subjected to identical conditions of exposure to mildew retain 95% of their original strength. (Fig. #2). Bursting strength recorded on Mullen Tester.

LIGHT PLANES, eyes of the Army, take cover with the troops among trees and underbrush, where fabric rotting due to mildew is unbelievably sudden and severe, especially in the tropics.

When Roxalin's fabric finish, EMYCEL, was first developed several years ago, it was specifically engineered to withstand mildew attack. Service records of Emycel finished planes prove its capacity to stand up in active use, under all climatic conditions.

Other reasons why EMYCEL is setting new standards for aircraft fabric finishing are such production advantages as the need for fewer coats and freedom from blushing in weather when doping with conventional materials is impossible.

The invention of EMYCEL is an example of Roxalin's original approach to finishing problems peculiar to the aircraft industry. Write us on your Company letterhead for further data on EMYCEL.

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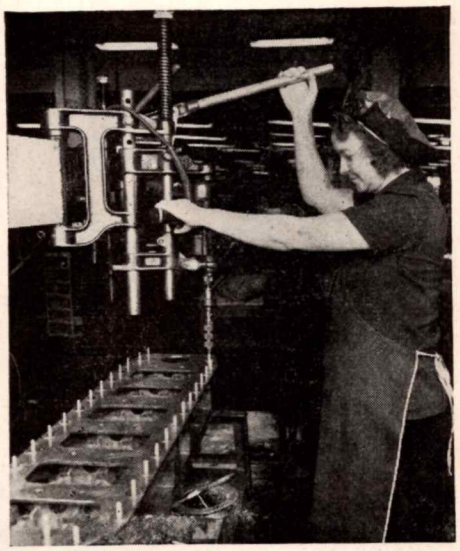
WAR TIME Production SHORT CUTS



Method of power-driving engine studs developed at Ranger plant, which effects great savings

Power-Driving of Stud Bolts Brings Big Savings

A practical method of driving aircraft engine stud bolts by power has been developed at Fairchild's Ranger Division plant, Farmingdale, N. Y. Applicable to all aircraft engine production lines, this technique bids fair to bring big money and man-hour savings.

Power driving of stud bolts has removed a bottleneck at Ranger where, as elsewhere in the industry, they were formerly driven by hand. Stud driving equipment used by other industries long ago had been proved unsuited and the hand method prevailed. The power machinery used at Ranger was designed by two production engineers, Phil Kilian and Frank Lucian, in collaboration with Chicago Pneumatic Tool and Stud-Craft Associates.

Under the new method, one man can drive in one hour all the studs he formerly drove in a full day with hand tools. He can do the job with less spoilage and closer adherence to tolerance. Whereas the work used to require considerable physical strength, it can now be done just as handily by women, an additional feature of advantage.

Before the development, it was necessary at times to transfer men from other work to do stud driving so that engine sections could be kept flowing to the production lines. Today, twenty-one of these comparatively inexpensive machines drive 90% of the studs in both the six and twelve-cylinder engines manufactured by the firm.

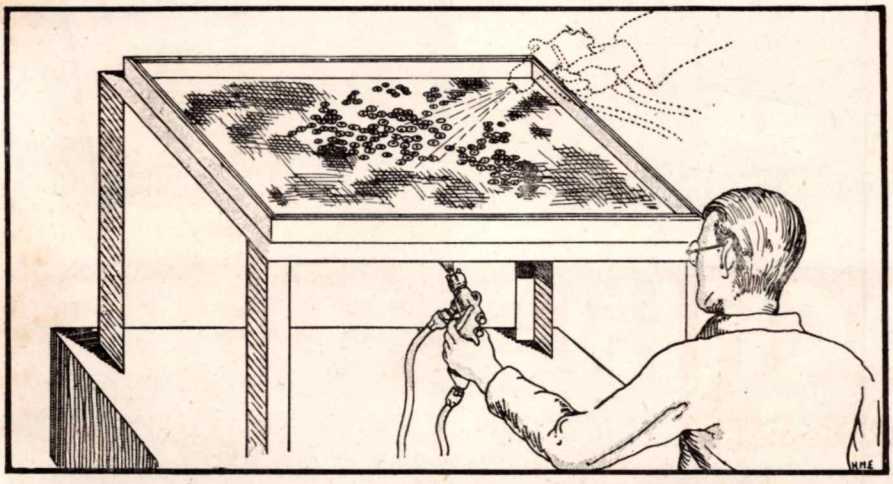
The machinery saves its initial cost every twenty-four days at present production rates at the Ranger plant.

Painting of Washers Simplified by Use of Wire Screen

The thousands of washers used in the assembly of an airplane must be painted on both sides. According to conventional methods, the parts were given a finish on one side, permitted to partially dry, and turned over for the second application of paint.

Mike Spak of the Murray Corp., Detroit, has taken both hand work and tediousness out of the job by spreading the washers on a wire screen and then spraying them from both top and bottom. The time required for the operation has been cut nearly in half, inasmuch as the washers need not be turned over and handled again.

Sketch shows how job of spray-painting washers at Murray Corp. is accomplished in just a little more than half the time previously required. Placing them on screen permits coating on both sides without turning washers over for second application



Wing Chord Divider Beam Aids Draftsmen in Layout Work

A wing chord divider beam developed by Fred Vasta of Fleetwings, is simple both in construction and use, and saves approximately 75% of the time normally required for calculating and layout work in this phase of airplane design.

A wing draftsman must frequently lay out a wing contour for a certain chord length. The first step in this process is to divide the chord length into specified percentages of the chord. Thus for each chord length a series of calculations involving percentages times chord length must be made before any ordinate lines can be drawn. Making these calculations is slow going

(*Continued on page* 371)

In Pan-American Repair Shops, it's..

WALKER-TURNER *Machine Tools*

Many thousands of Walker-Turner Drill Presses, Metal Cut-Off Machines, Radial Drills, Band Saws and other Machine Tools are used in the *manufacture* of aircraft. But in aircraft *maintenance*, also, as in the repair shops of Pan American World Airways System, the extraordinary versatility of these units is clearly demonstrated. Their exceptionally wide range of operating speeds enables them to cut all kinds of materials—an important consideration in handling the varied jobs that come to repair shops. Send for catalog.

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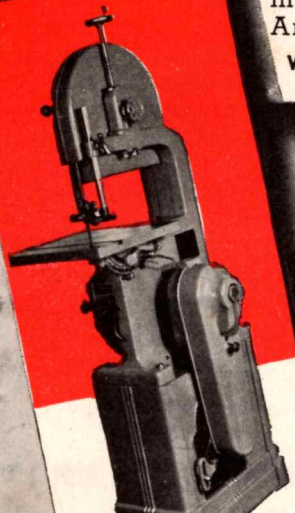

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14 in. and 16 in. models. Back gearing and cone pulleys provide speed range from 61 to 5300 s.f.m. for cutting practically any material from steel to wood.

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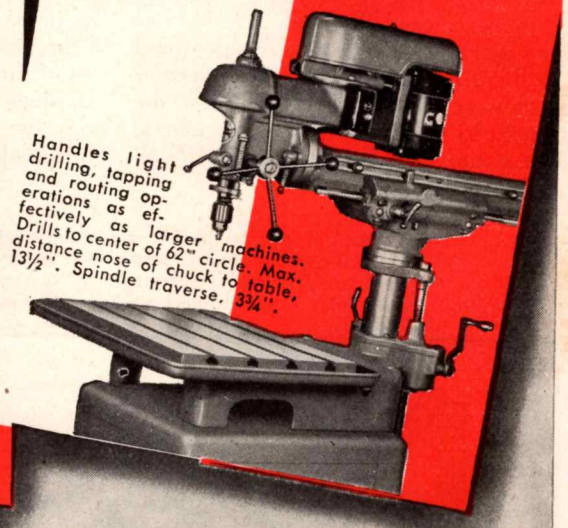

Handles light drilling, tapping and routing operations as effectively as larger machines. Drills to center of 62" circle. Max. distance nose of chuck to table, 13½". Spindle traverse, 3¾".

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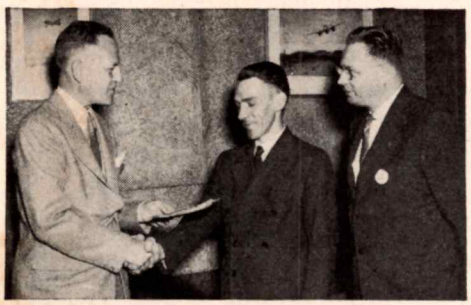
EACH MONTH AERO DIGEST awards a $100 War Bond to the person or persons whose production short cut, described in these columns in the previous issue, is considered most valuable by the judges. If more than one person is responsible for the winning short cut, the award will be divided equally. The decision of the judges is final.

THE JUDGES are: Dr. Alexander Klemin, Consulting Editor, AERO DIGEST, Chairman; Alvin E. Dodd, pres., American Management Assn.; Frank J. Oliver, American Society of Tool Engineers; Col. James L. Walsh, War Production Committee, American Society of Mechanical Engineers; R. F. Gagg, representing Society of Automotive Engineers.

ROLL OF RECENT WINNERS



Paul J. Frizzell, Asst. General Manager, presents October AERO DIGEST Award to Franklin M. Carpenter, Fairchild worker. At right, E. L. Buchanan, General Factory superintendent

Louis Fahnestock
Fairchild Aviation

Edmund Klonowski, Robert C. Miller, Jr. and Vernon King
Bell Aircraft Corp.

C. R. Stevenson, A. H. Haberstump and V. J. Lovett
Murray Corporation of America

Arthur Chism
Reynolds Metal Co.

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Westinghouse Elec. & Mfg. Co.

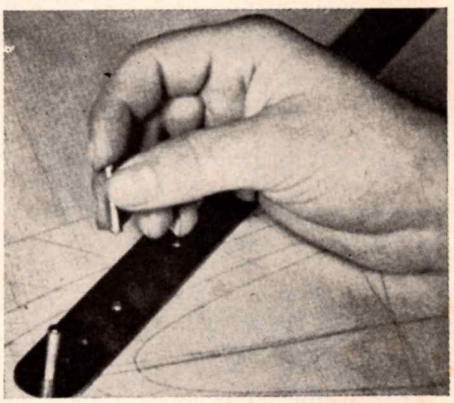
Dr. R. C. Burt
Lockheed Aircraft Corp.

ASK YOUR COMPANY to send in a detailed description of your production short cut, attesting to its actual adoption, together with a photograph or drawing.

(*Continued from page* 369)

and can often result in error. It is for the elimination of the calculations that the new instrument is used.

Two bars of equal length are hinged together providing the equivalent of hinging an oversize chord line at the 50% point. Both bars are perforated with a number of small holes which have been drilled at various intervals, each of which represents a certain chord percentage. The 0 and 100% marks at the ends of the hinged bar are located at the leading and trailing edge points with steel pins. Then the intermediate points are marked by placing a third pin in the various small



Wing chord divider beam developed by a Fleetwings engineer saves 75% of time normally required in layout work for plane design

holes. These points are then projected down to the chord line, thus dividing it into the desired percentages.

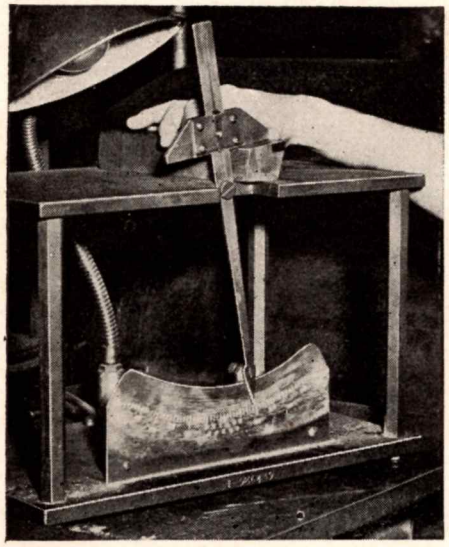
It is obvious that this mechanical method of calculating and scaling is infinitely faster than the manual approach and likewise precludes error.

One of these wing chord divider beams is easy to make, and the material required is negligible. The two steel bars measure 1 in wide and .095 in thick. They are hinged together by means of a flush rivet which has been drilled out to permit placing the small pin through. The holes indicating percentages are of 3/16 in diameter and the pin, which fits snugly, has a fine point measuring .040 in at the base. Accurately made—preferably machine-divided—this device should be a time-saver in any aircraft engineering department.

Ingenious Device Checks Tool Angles Quickly

A protractor designed by L. T. Weller of General Electric's Schenectady Works laboratory greatly facilitates checking of the rake and clearance angles in relation to the bottom surface on cemented carbide tipped cutting tools.

The straight edge pivots on a shoul-



Checking of tool angles is facilitated at General Electric by this ingenious protractor device

der screw at the surface plate. Its lower portion is tapered and pointed to coincide with the scale calibrated in 1° graduations 1/8 in apart for easy reading.

Gang Stop Device Facilitates Cut-off Saw Operation

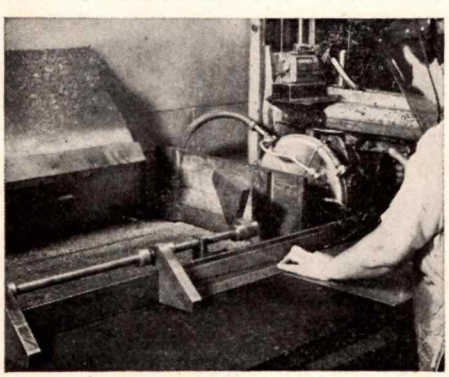
At Northrop Aircraft, Marvin B. McCoy, of the sheet metal department has devised a new gang stop device to be used on the cut-off saw.

Formerly, the cut-off saw operator was limited to one stop with which to gage lengths of the material to be cut. To get out a different length, the set up had to be broken down and the stop adjusted to the new length—a time-consuming procedure.

The new gang stop device is equipped with six stops, all adjustable. The stops are set to accommodate the various lengths required for an order at the beginning of a run. After sawing each length, the stop for that length is thrown up and the stop for the next length required is thrown down.

This gang stop provides a multiple set-up for the cut-off saw. By saving time formerly used to change the one stop set-up every time a new length was required, it is estimated the ratio of improvement is six to one.

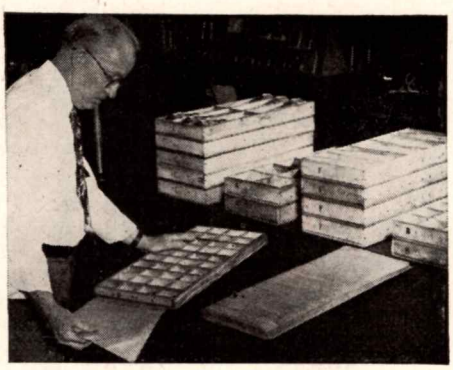
Gang stop developed at Northrop affords means of cutting stock lengths complete in a single operational sequence on the cut-off saw



Paper Liners for Small Parts Trays Expedite Cleaning

Cleaning small-parts trays is one of the nuisance jobs in war plants. Until recently, Buick's wooden trays were fitted with removable partitions, to facilitate the cleaning of grease from the bottom of the trays. Although this system worked fairly well, the partitions were frequently lost, and now and then the workmen appropriated them for purposes of their own. The company was faced with a high replacement of trays.

To remedy the situation, John J. Johnston, of the materials handling department of the bomber engine plant, proposed that the trays be built with a 3/16 in slot at one end, and that grease-proof paper liners be inserted in the bottom of the trays. To facilitate the insertion of the paper, a strip of sheet metal a few inches longer than the tray is used to guide the liner into position. In the new trays, the partitions are permanently fixed to the sides of the box, thereby preventing losses.

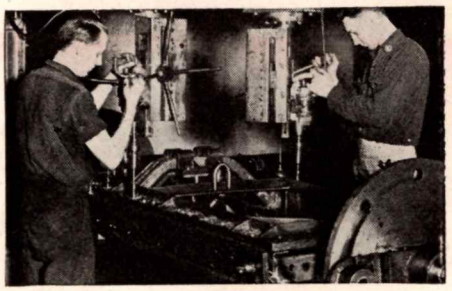


Developed by a Buick worker, paper liners for use in spare parts trays expedite cleaning

The new design has simplified cleaning. All that is necessary is to remove the paper liner and insert a new one. When sides and walls become dirty, trays are cleaned with a standard washing compound. The maple or oak construction of the trays prevents warping. Twenty-four man-hours per day are saved by the new cleaning methods, and a great many more trays are available at all times because of the reduction of losses.

Production Jam Averted by Improvised Drill Press

When a light radial drill press was needed in a hurry at General Electric's Erie Works, such a machine was improvised by utilizing scrap materials and portable electric drills. Mounted on the radial arms by close fit, each head is positioned manually, and the drill is fed into the work by turning the hand-wheel.



Improvised drill press, made from scrap materials and a portable electric drill, works satisfactorily on light pieces, averting production jam

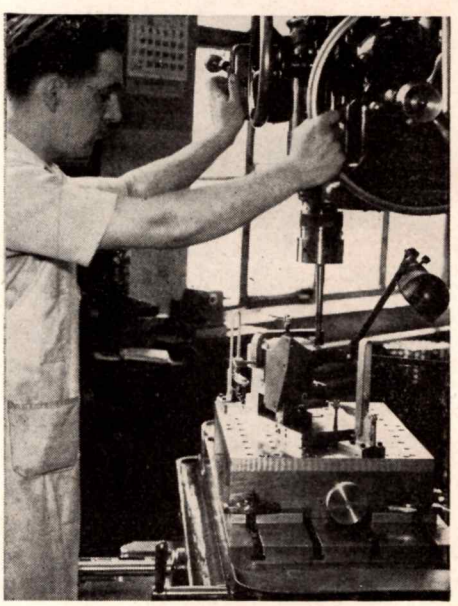
Weights suspended from cables at left and right run over a pulley atop the columns to counterbalance the radial arms. The hydraulic cylinders perform the function of a lifting screw. The improvised machine drills light materials satisfactorily.

Fixture Locating Plate Speeds Changing of Jobs on Jig Borer

A jig-borer plate for a retractable centering pin to locate work clamped to a master plate has been devised by a worker at General Electric's Schenectady plant for use where a large variety of small parts must be bored on a short-run basis.

The arrangement allows the operator to change quickly from one job to another without relocating the center. In addition, he can change from a fixture operation to a clamp-down operation without removing the jig-borer plate. Bolt holes tapped in the plate

(*Continued on page* 375)



Fixture-locating plate, designed at General Electric, speeds changing of jobs on jig borer when a large number of parts must be processed on short-run basis

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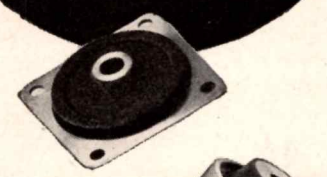
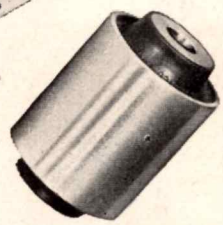
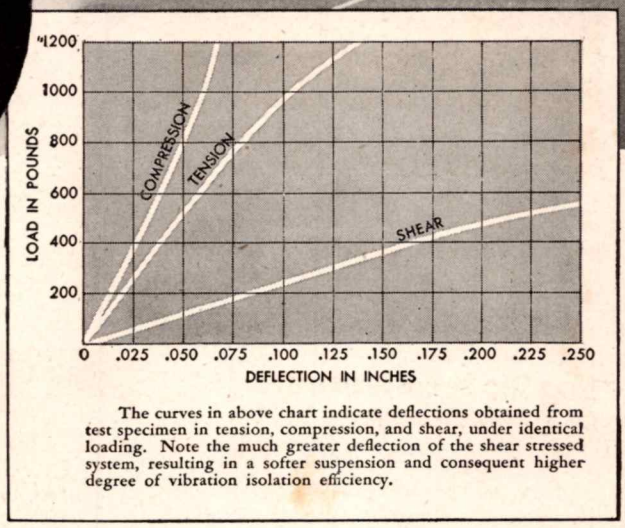
MOUNTINGS

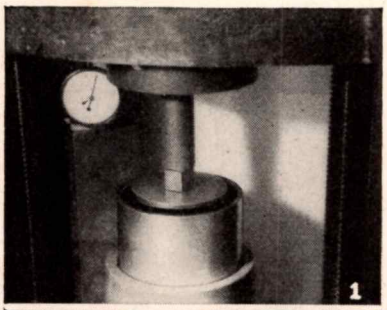


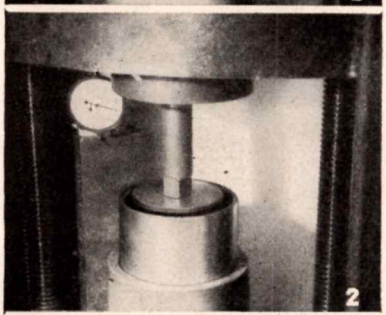


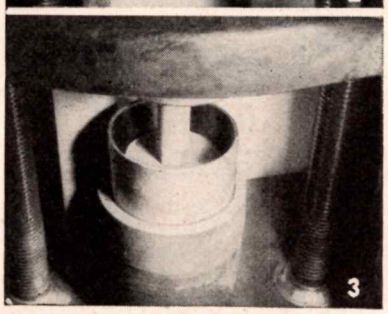


The curves in above chart indicate deflections obtained from test specimen in tension, compression, and shear, under identical loading. Note the much greater deflection of the shear stressed system, resulting in a softer suspension and consequent higher degree of vibration isolation efficiency.

Photographs proving strength of Lord Shear Type Mountings







The above tests were made using a Lord Tube Form Mounting 5½" O. D. x 4½". Figure one shows mounting under no load. Figure two shows mounting stressed in shear under its rated load of 2,200 lbs. Center sleeve is depressed 1/16". Figure three shows same mounting under 50,000 lbs. load (press capacity). Center sleeve is depressed 1 13/16" and shows no failure of rubber-to-metal bond, even with more than 2000% overload.

TO obtain the highest degree of vibration control or isolation efficiency, a flexible suspension must be employed which is soft in the direction or directions of the disturbing forces, thereby providing adequate axial deflection, and maintaining ample stability in directions normal to the major thrusts.

The only mounting design which incorporates these features is one in which the rubber is *stressed in shear.* Rubber in shear is much softer, yields more readily than in tension or compression, and consequently greater deflections can be obtained from a given size rubber element. (See chart)

Lord, by developing and perfecting a process for forming a strong and uniform bond between rubber and metal, has been able to apply this principle of shear stressed rubber to two basic designs of vibration isolation mountings, plate form and tube form, and other bonded rubber products including flexible couplings, torsion bushings, radius rod joints, turnbuckles, and diaphragms.

This process, which produces a bond as strong or stronger than the rubber:

1. Facilitates the manufacture of a simple, rugged, compact, lightweight mounting, allowing full shear freedom to the rubber element.
2. Will bond firmly and directly to various metals—Low and High Carbon Steels . . . Alloy Steels, Brass, Aluminum, and Monel Metal.
3. Produces a high ratio of bond strength to working stress providing an ample factor of safety under all loading conditions.

Lord Mountings, in plate form and tube form, with snubbing or non-snubbing features are made in various shapes and many sizes, with load ratings ranging from a few ounces to several thousand pounds. Millions of Lord Mountings and other Bonded Rubber Products are being used in almost every type of military and naval equipment, as well as in practically every field of industry, providing protection against the harmful effects of shock, vibration, and noise translation. Investigate the possibility of including them in *your* new equipment designs.

Complete information covering all Lord Mountings, as well as an engineering discussion on vibration control, is contained in Bulletins 103 and 104. Lord Vibration Engineers are available for consultation on your design problems. Write today. There is no obligation.

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IT TAKES RUBBER *In Shear* TO ABSORB VIBRATION

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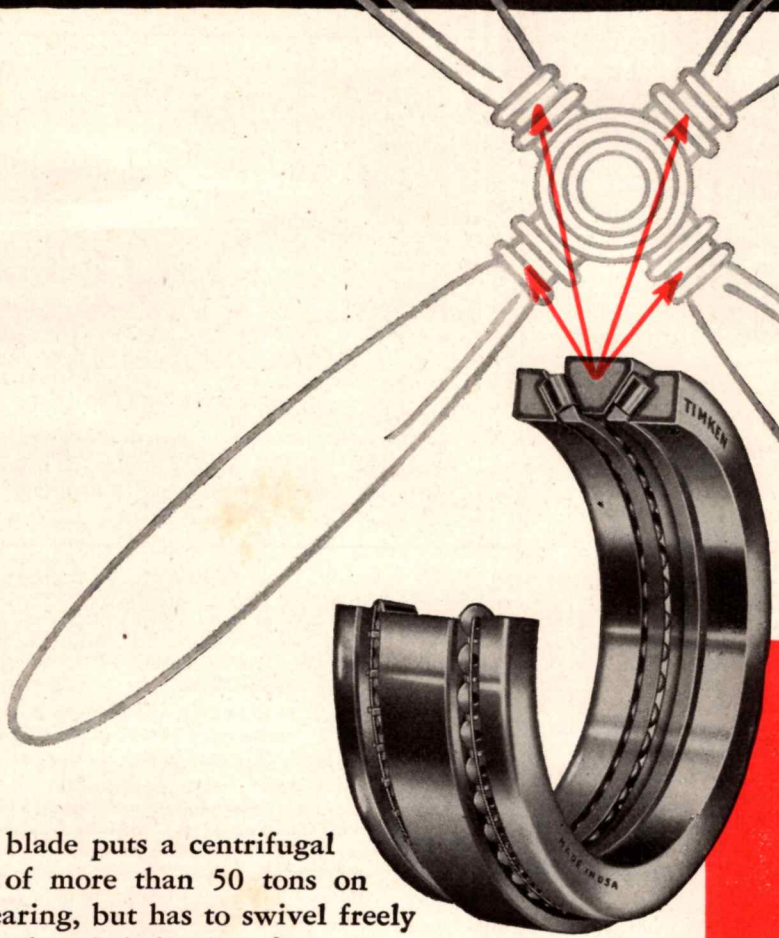
Originators of Shear Type Bonded Rubber Mountings

Over 50 Tons
the weight of two flying "FORTS"
ON EACH BLADE BEARING

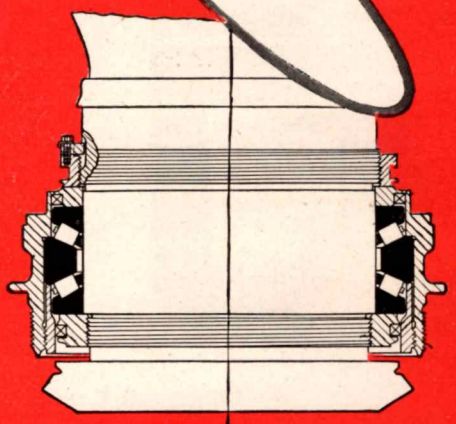


Each blade puts a centrifugal load of more than 50 tons on its bearing, but has to swivel freely when the pitch is altered.

Yet that, comparatively, is the easiest part of the bearing problem. Various tilting forces must be taken into consideration; those due to inertia, those due to heavy propelling thrust, and those due to gyroscopic effects.

All these forces, applied at a long leverage, have to be carried by a few rollers on opposite sides of a base of only 6¾" span.

The section shows the specially developed Timken Tapered Roller Bearing that carries these complex loads with freedom of action, but without a hint of backlash. On your bearing propeller feathering problems consult The Timken Roller Bearing Company, Canton, Ohio.



HIGHER LOAD CAPACITY
INCREASED STABILITY

Wherever the Timken Tapered Roller Bearing is used it results in higher load capacity and increased stability against every combination of stress. This illustration shows Timken Bearings as mounted in the hub of a controllable pitch propeller blade.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

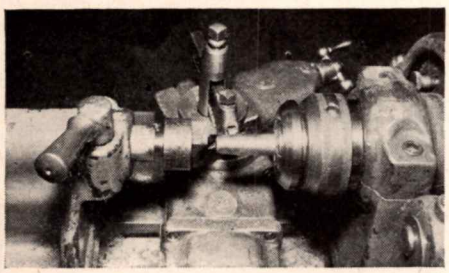
(*Continued from page* 372)
at 2 in centers make this possible.

The jig-borer plate is made of 1 in stock, 15 in wide and 20 in long. An L-shaped leg at each end of the plate raises its top surface 4 in above the table and provides a means for strapping down the device.

The retractable pin, centered directly under the spindle, is raised or lowered by a shaft arrangement extended through one of the legs. The pin slides through a bushing set in the plate with a press fit.

In fabricating the jig-borer assembly, the legs are welded to the plate after which it is stress annealed. Holes are bored in the plate after it has been trued with the table.

Radius Cutter Simplifies Rework Operation



Radius cutter developed at Vega plant eliminates changing of tools while turning resistance welding electrodes

A radius cutter has recently been developed in the tool engineering department of the Vega plant, for rework operations on resistance welding electrodes. This tool may be used in any lathe which has a No. 2 Morse tapered tail stock.

The cutter completely eliminates changing of tools while turning resistance welding electrodes, since all operations may be performed either simultaneously or in sequence. Initial cost of the cutters is well under $5.00 and savings in rework time alone at the Vega factory have been estimated at almost $500 per year.

Deburrer for Lightening Holes Speeds Bulkhead Output

One of the major deburring problems in the aircraft industry has for some time been burr removal and generating of radii on the inside diameter of lightening holes. The holes ranging from 2 to 7 in in diameter cut or stamped in the Duralumin stringers and bulkheads. The rough, uneven surface left by the router or stamping machine must be smoothed out and a slight radius produced around the edges of the hole before the piece may be used. Performed by various hand methods utilizing coated abrasives or scrapers, this operation has consumed an inordinate amount of time.

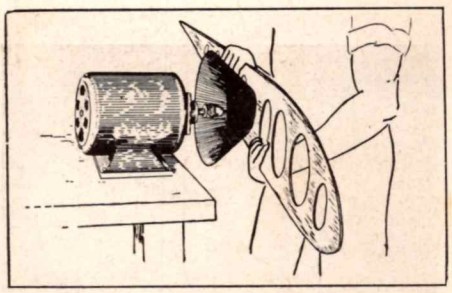
An improved technique has been devised by Russ Mannette and Walter Trezise, working in conjunction with the product engineering department of Behr-Manning. This new method, having shown itself an efficient time-saver, has met with the approval of several of the larger plane manufacturers in the East.

The new method utilizes a specially shaped, unjoined coated abrasive cloth cone mounted on a special cone adapter, both being designed for specific use as a lightening hole deburrer. The accompanying illustrations show the cloth cone mounted on the adapter. It should be noted that these have been designed with a 45° angle, determined after considerable experimenting with various angles.

Alternate Methods

Although several methods of mounting the deburring tool are possible, its most efficient use appears to be when mounted on the shaft of a standard 1800 rpm motor of 1/3 to ½ hp, depending on the size hole and the gage of stock. The motor may be attached to the bench with the shaft at right angles to the front edge so the cone will overhang, allowing the operator to bring the sheet being sanded to the cone. Optional mountings on drill presses and so on are of course possible, provided the cone is not operated in excess of 2000 rpm.

In general, grit #80 cloth cones are used to deburr holes cut with routers,

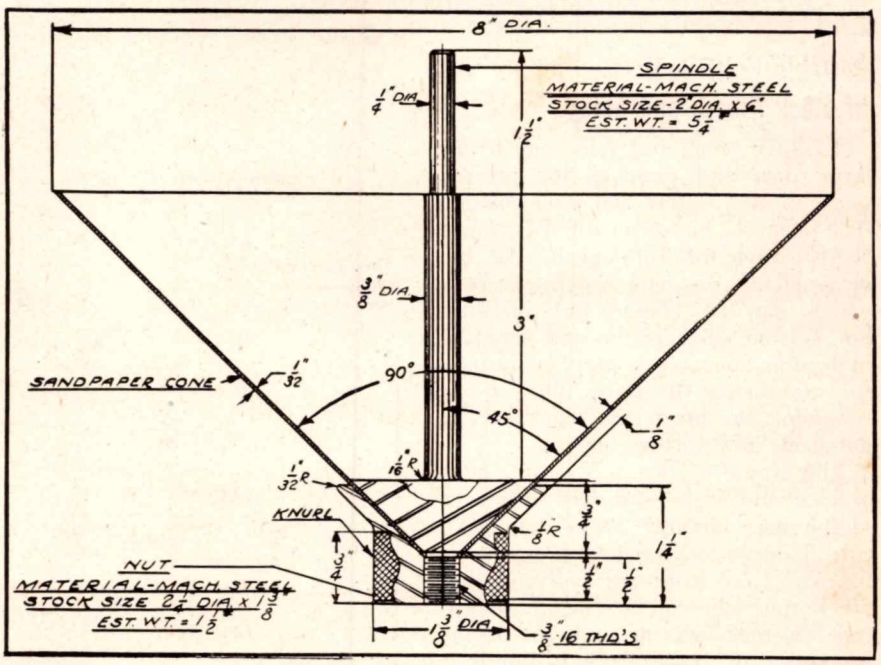


Set-up for application of new deburring tool, used in the generating of radii on inside diameters of lightening holes

this usually being the heavier gage Duralumin. Lighter gage stock is stamped out as a rule, and grit #120 cloth cones have been found more acceptable on this operation. Although these cones may be applied to the adapter unjoined and lapped over, the best results have been obtained by clipping the cone together at the ½ in overlap with an ordinary paper stapler. This insures the cones' staying in position at all times while in use.

In actual operation, the stringer or bulkhead lightening holes are sanded to a fine, rounded edge by forcing the lightening hole over the revolving cone to a point where the cone is slightly larger in diameter than the hole being sanded. The pressure thus exerted on the cone causes it to conform to the hole, thus removing the burr and producing a radius on the lightening hole. As the diameter of the cone varies from 2 in at the top to 8 at the base, practically any conventional size lightening hole may be deburred on this 45° angle cone.

Deburring operations on stringer and bulkhead lightening holes have been speeded by use of a new tool devised by Behr-Manning technicians. Diagram shows its construction in detail



Router caliper designed at Northrop facilitates choice of proper-size pin by automatically giving diameter

New Router Caliper Gives Pin Diameter Automatically

A router caliper which automatically gives the diameter of the pin to be used in relation to the dimension of the cutter has been developed at Northrop Aircraft by Harry Becher, form block maker in the company's wood working department.

This caliper, which enables a quick selection of the proper pin, is very useful where cutters have been sharpened many times. It has two sets of jaws, one set 7/16 in larger than the other set. This relation is maintained.

To get the diameter of the pin, the cutter dimension is taken. The opposite side of the caliper, on inspection, gives the pin dimension—the difference between the two being a constant.

Portable Hoist Built of Stock Pieces and Scrap

To save time and labor in lifting large dies and punches for presses, large sheets of steel and steel castings that formerly had been lifted by hand, H. E. Boyle of Pittsburgh, Pa. has designed a one-man operated hoist which can be constructed in three hours from stock pieces and scrap. A hydraulic floor truck may be utilized for mobilizing the hoist. By simply removing the hoist, the truck can be put back into normal service.

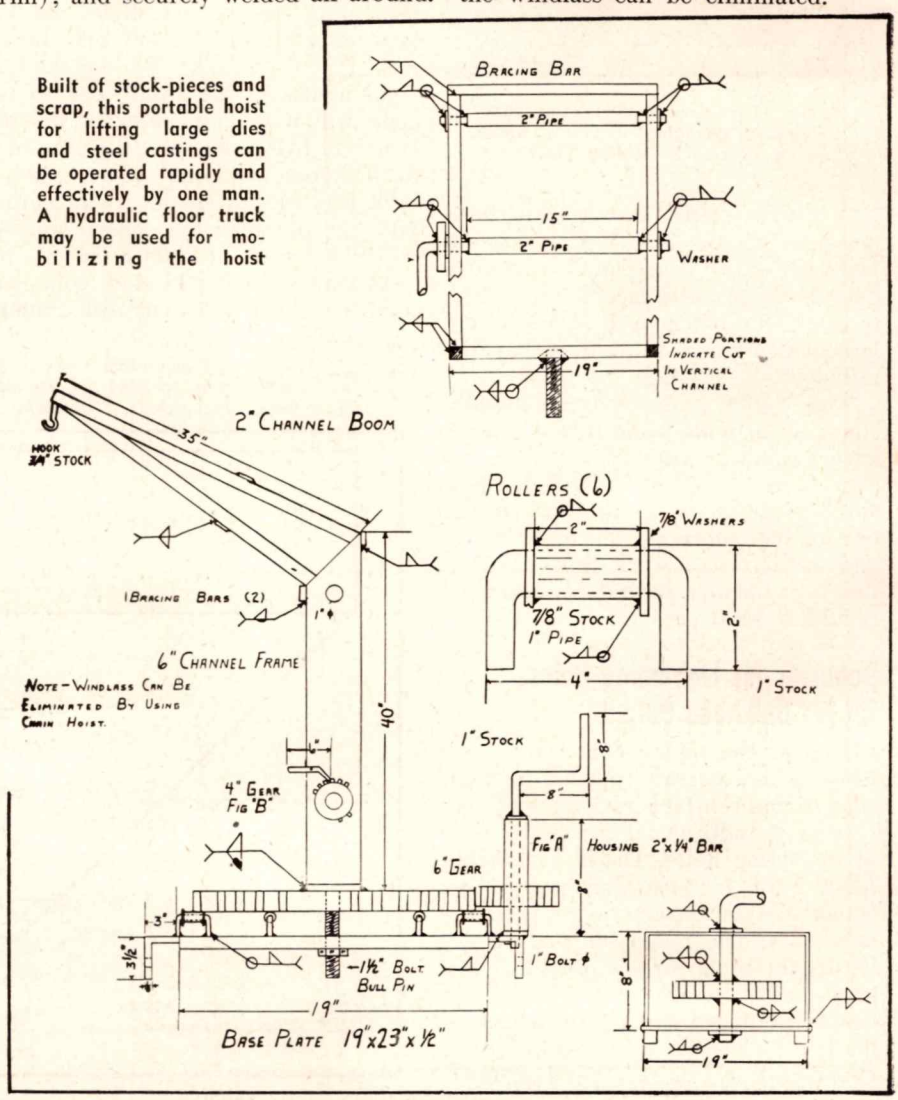
The frame of the hoist is made of 6-in channel iron—2 pieces 40 in long and a base channel 19 in long. The two flanges (on vertical pieces) are burned 2 in from the end to allow the bottom channel to engage snugly, then welded all around to insure strength. A 1½-in hole is bored in the center of the bottom flange for a bull pin. Tops of vertical channels are burned off with a 40-0 cut to accommodate the boom. The boom, of 2-in channel iron, is welded securely to the frame, (flanges facing inward) with double fillet welds on top, bottom and back of each channel. The two top channels are burned at an angle to fit the top of the vertical frame. All four 2-in channels are toed in to meet in the center where they are again securely welded.

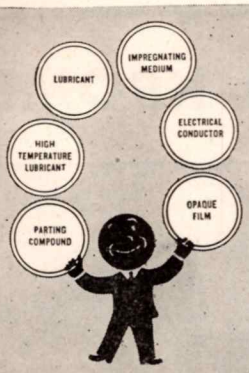
Bracing Bars for Rigidity

Next, two bracing bars are welded to the frame at the tops and bottoms of the angle cut, and two to the top and bottom of the boom, to insure rigidity. The boom hook is made of ¾-in round stock, and is welded to the boom end. A 1½-in bolt is inserted in the hole in the bottom channel and welded all around on both sides. The frame is now placed with bull pin through the shaft hole on a 19-in stock gear (the shaft hole having been burned level with the gear rim), and securely welded all around. A 1½-in hole is bored through the center of the base. The rollers are made of 1-in pipe, laid out and welded to the base plate.

Now, four pieces of stock are drilled and bent and welded to the corners of the plate, for anchoring lugs. The gear housing is formed by welding a piece across the tops of the lugs. The rest of the housing is formed of one piece, bent in two places, and welded to the bottom piece. A 1-in hole through top and bottom of the housing accommodates the shaft. The gear is next welded to the shaft and held in position with two washers. The base assembly can then be fitted to the truck by boring four holes through its sides to fit the lug holes on the plate, thus permitting removal of the anchorage of the entire hoist by the unfastening of four bolts. The hoist assembly is secured to the base by means of the bull pin. The windlass assembly can be made from 1-in stock and 2-in pipe, with washers holding it in place. With the attaching of a shop block and tackle, the hoist is ready for use. If a chain hoist is obtainable the windlass can be eliminated.

Built of stock-pieces and scrap, this portable hoist for lifting large dies and steel castings can be operated rapidly and effectively by one man. A hydraulic floor truck may be used for mobilizing the hoist





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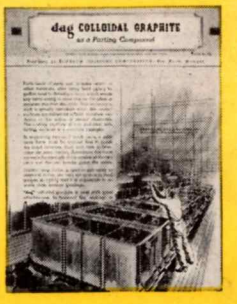
ASSEMBLING AND RUNNING-IN ENGINES AND MACHINERY

Lists 10 advantages of adding **dag** colloidal graphite to liquid lubricants for these operations and tells why with photographs, charts, and simple, non-technical text.

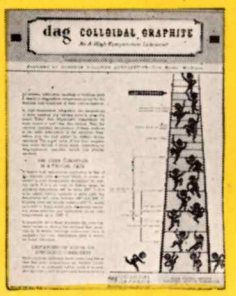
BULLETIN No. 421

PARTING COMPOUNDS



Tells how **dag** dispersions prevent objectionable freezing, rusting or sticking together of metals and other materials. Cites use on screw threads, lamp bulbs, aviation and driving equipment; also in glass, rubber and foundry industries.

BULLETIN No. 422



HIGH TEMPERATURE LUBRICATION

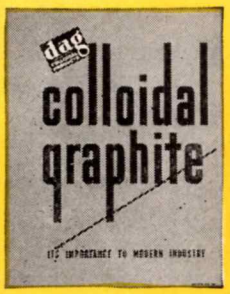
How **dag** colloidal graphite takes over when the going gets too hot for conventional liquid lubricants. Gives examples in forging, oven conveyors, kiln cars, bottle and die casting machines, etc.

BULLETIN No. 423

"dag" COLLOIDAL GRAPHITE FOR IMPREGNATION AND SURFACE COATING

of textiles, asbestos, felt, abrasives, porous metals, paper, wood, etc. to impart lubrication properties, electrical conductivity, opacity, color, or other desirable qualities.

BULLETIN No. 431



GENERAL BOOKLET

The story of **dag** colloidal graphite. 12 pages fully illustrated. Gives the how and why of colloidalization, explains the various liquid carriers and suggests dozens of places where **dag** dispersions can speed up production.

BULLETIN No. 430

dag COLLOIDAL PRODUCTS

ACHESON COLLOIDS CORPORATION
Port Huron, Michigan

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Our Present Oil Supplier Is_____

(Lubricants containing **dag** colloidal graphite are available from major oil companies.)

Dept. A

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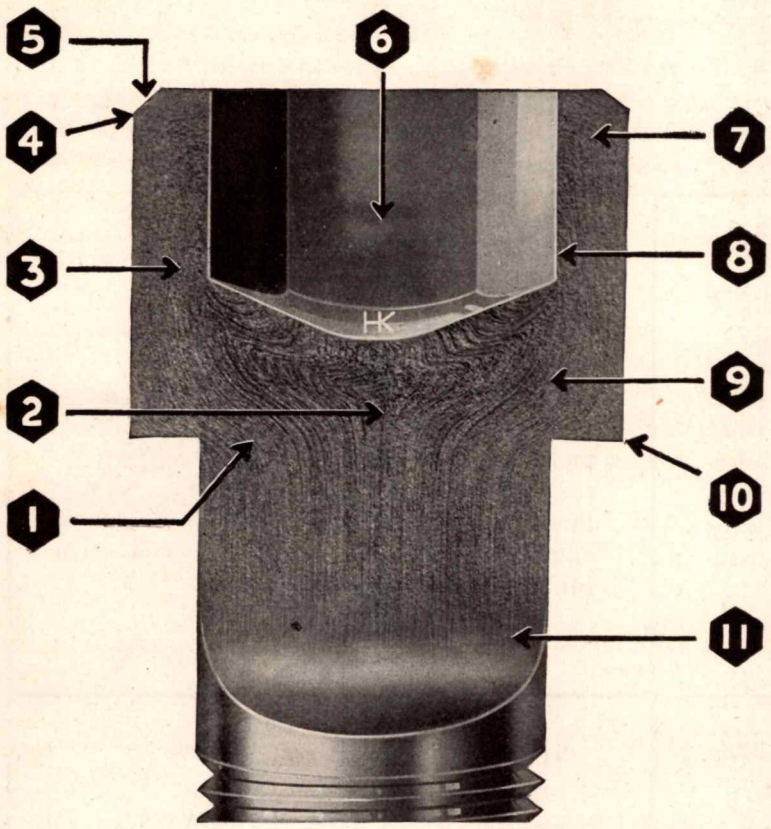

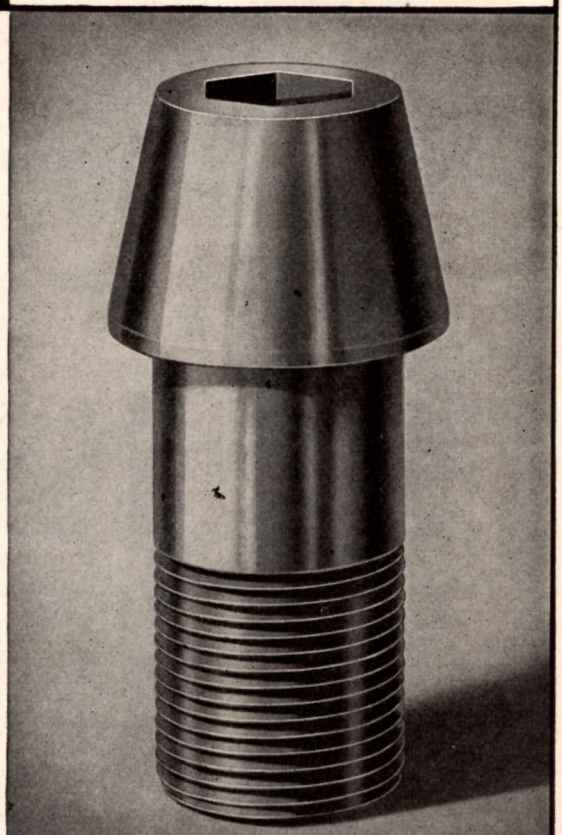

Unretouched Photo Etched Cutaway Holo-Krome Bolt

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4—SMOOTH FLAT TOP WITH SLIGHT CHAMFER.
5—CONCENTRICITY OF HEAD WITH BODY.
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8—REINFORCED SOCKET WALLS.
9—CONTINUOUS UNCUT FIBRES.
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11—ORIGINAL CONTINUOUS FIBROUS STRUCTURE.

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DIGEST OF THE NEWS

OCTOBER OUTPUT PASSES 8000 MARK—A NEW RECORD

110,000 Airplanes Produced in First Twenty-One Months Since Pearl Harbor—Labor Situation

The industry's accelerated output is reflected in the returns for October which reveal an all-time high of 8300-odd planes, and by the first complete production figures on aircraft since Pearl Harbor, currently released by the War Production Board.

Charles E. Wilson, acting chairman of WPB, reveals that a total of 110,000 airplanes have been produced in this country during the twenty-one months ended September 30. This stands over against the goal set by President Roosevelt, of 185,000 by the end of 1943. The President asked originally for 60,000 planes last year—representing the 5000-planes-per-month average which was finally topped in December 1942—and an additional 125,000 by the close of this year. While previous reports (AERO DIGEST, September) have indicated that this year's monthly goal of 10,000 odd planes would not be attained until 1944, Wilson pointed out that the rate of output of aircraft within a short while should reach 9000 a month.

At the same time he disclosed a slight decrease in September production, which was 7598 as compared with 7612 in August.

The subsequently announced figure of 8362 planes, recorded for the month of October, represents an unmistakable renewal of the upward trend.

From the 5000 airplanes produced in January 1943, aircraft production steadily increased through August, the previous peak month, which reached over 75% of the monthly goal. Following the September slow-up, the October output figure is especially heartening.

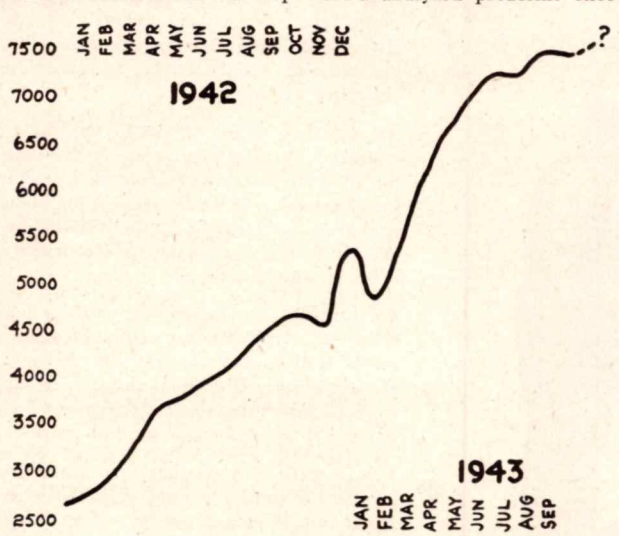
Manpower Problems

Officials attributed the lower September figure largely to West Coast manpower problems which only reached a workable solution in the middle of that month. The labor-budgeting system now in use, they pointed out, is clearing the way toward a definite increase in production for November.

In consonance with the expected increase in output in coming months, the administration has announced draft deferment for "all necessary workers in west-coast plants, including their production subcontractors."

Shortage of labor, nevertheless, is still one of the most frequent complaints of aircraft plants, while other difficulties encountered include design changes, failure of parts or materials to arrive on schedule, and cut-backs.

A note of optimism featured Wilson's announcement that September production of four-engined bombers—more than 6 percent above the August figure—was up to schedule. He added that the dollar value of planes produced in September increased 4 percent over the previous month and that the total airframe weight figure was up 3 percent.



How U. S. aircraft production, maintaining a comparatively steady growth since January 1942, is approaching the 10,000-per-month goal set for 1943

Sees 300,000 Civil Aircraft within 3 Years after War

Current and future air transport problems dominated the discussions at the meeting of the Institute of the Aeronautical Sciences in Washington, D. C., on Oct. 26th and 27th. Charles B. Donaldson, director of airports for CAA, highlighted the two-day session with his estimate that in 1946 domestic airlines would fly over six billion passenger miles and that within three years after the war it might be reasonable to expect over 300,000 civil aircraft to be in operation. Donaldson pointed out that the Army's Air Transport Command expects to fly routes in 1944 aggregating ten times the combined length of all the world's pre-war commercial airlines. He placed at 6000, the number of domestic airports that will be required in the early post-war years.

Col. Harold R. Harris of the ATC analyzed problems encountered on the globe-circling routes of the Command. Colonel Harris enumerated the lack of adequate airports and housing and hangar facilities, along with "the problem of transporting gasoline, food and supplies by rudimentary methods to isolated bases," as among the foremost difficulties that must be coped with in foreign lands.

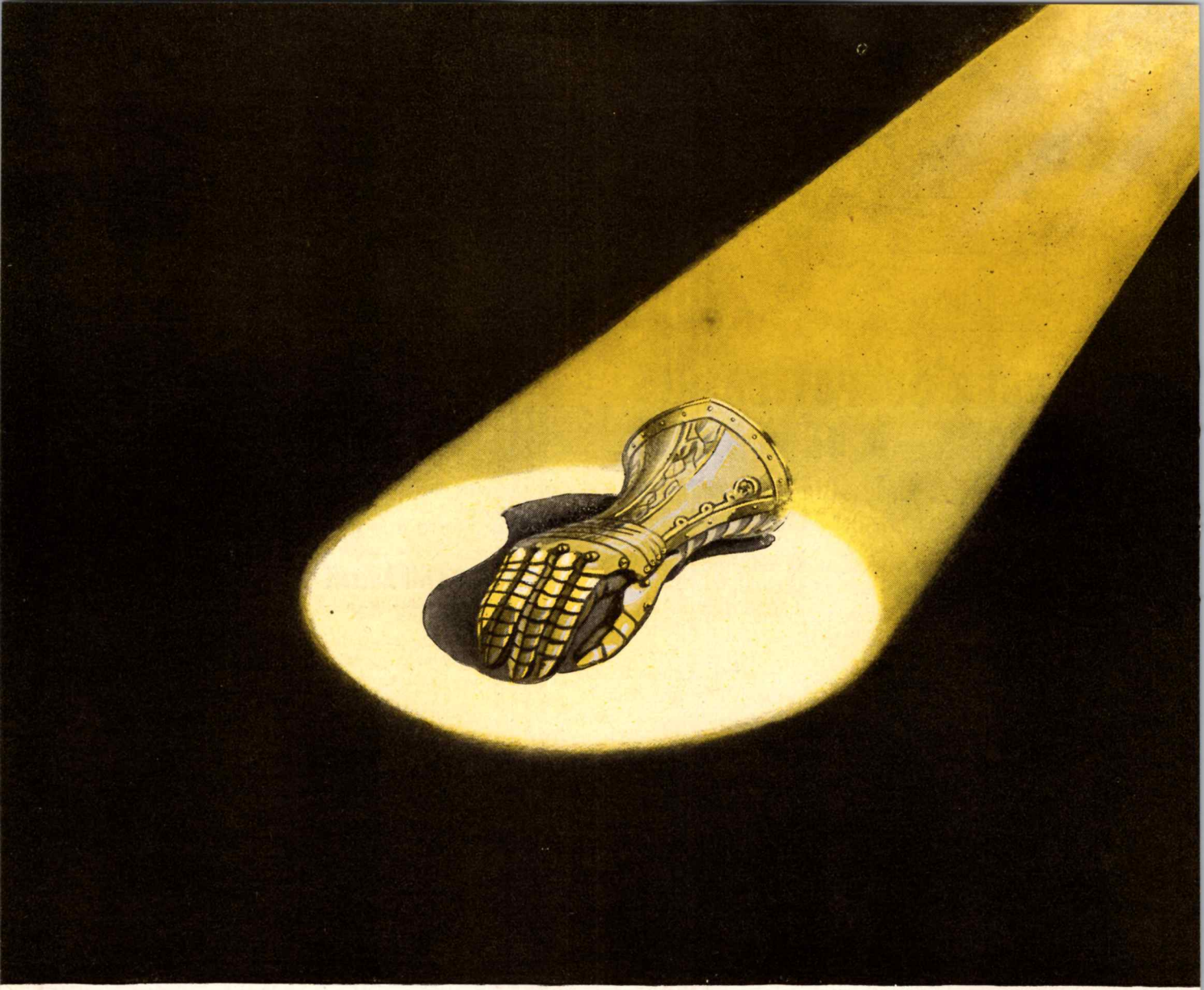
The "Effect of Airport Operating Characteristics on Runway Patterns" was discussed by John C. Leslie of Pan-American Airways, who had compiled data on this subject in cooperation with Harold E. Gray, chief pilot, and John J. Ford, operations engineer. Leslie stated that under reasonable wind conditions the triangular system would be acceptable and that it would not seem logical to spend the money for the additional runway required by the quadrilateral pattern. Leslie proposed for the consideration of airport engineers an airport design having a "double-vee" set of runways permitting two simultaneous take-offs and landings and a correspondingly greater volume of traffic.

Littlewood Cites Needs

William Littlewood, vice-president in charge of engineering, American Airlines, told the group that air transport planning should be in the direction of utilization of as large aircraft as possible over as long ranges as are consistent with the services to be rendered. He emphasized that without improved ground transportation facilities, express highways and bus and truck connections, plans for a rapid development of local transportation would be more theoretical than real.

F. W. Reichelderfer, chief of the U. S. Weather Bureau, observed that although navigational aids will make possible air transport operations in all kinds of weather, the effects of strong winds and other atmospheric conditions on operating efficiency will force further development and extension of weather service, particularly over the oceans.

(*Continued on page* 381)



A CHALLENGE TO AMERICANS "WHO GET THINGS DONE

Right now we are up against the hard, blunt facts of war and the grim necessity of winning it. It's the one thing that matters with no alternative but complete and final Victory.

At the same time, it's only natural to wonder about the future—to think about the time that is coming after the last shot in this conflict is fired. And you can be sure that the future will be a challenge. We won't just slip back to the world we knew before hell broke loose.

For winning the peace will call for just about as much all-out effort as all-out production does now to win the war. We will have to do something with our tremendous productive capacity—our vast industrial plants — our skilled workers.

Yes, it will be a challenge to American business ability, the kind of a challenge Americans "who get things done" like —a challenge of their capacity to organize—manage—produce. It will be a new industrial age, an age of new materials new techniques, new precisions. Supplying the needs of that future will take all that industry can produce and deliver.

Kearney & Trecker Corporation sees that kind of an America in the years after the war and is making its plans accordingly. No matter how long and hard the fight—it's worth it for the America of tomorrow

KEARNEY & TRECKER
CORPORATION
Milwaukee Wisconsin

KEARNEY & TRECKER
CORPORATION

"Buy Victory with War Bonds"

MACHINE TOOLS

(*Continued from page* 379)

William A. M. Burden, special aviation assistant to the Secretary of Commerce, stated that the growth of aircraft movements controlled by Airways Traffic Control had increased from 150,000 in 1937 to over one million by 1939; and he estimated that by 1950 it would increase at the rate of from eight to ten million per year. He estimated the number of air carrier passengers at twenty million per year by 1950.

Loening's Glider Predictions

Grover Loening, consultant on aircraft for the WPB, predicted that the glider air train a few years hence would become one of the most important fundamentals of air transportation.

Edward P. Warner, vice-chairman of CAB, in discussing the requirements of local air transport service, gave what he believes to be a reasonable goal for complete coverage of the United States by air facilities. He stated this would entail an increase in the number of airline stops from the present 284 to about 3400, the increase of air route mileage within the country to about 200,000, and the flying of about 750 million airplane miles each year which is more than the present annual passenger train mileage.

Acme Photo

Chilean Army air force officers on inspection tour of U. S. airplane plants. With Gen. H. H. Arnold, chief of USAAF, are, l. to r.: Col. Edison Diaz, Brig. Gen. Oscar Herreros, Gen. Arnold, Lt. Gen. Manuel Tovarias and Lt. Col. Javier Undurraga

Chamber of Commerce Adopts Post-War Policy

The International Transport Committee of the Chamber of Commerce of the United States today has received approval of its policy for the post-war international transport for this country. The committee recently submitted its recommendations to the Chamber and a vote of 20% of its member organizations in 20 states at the least ratifies the Committee policy as Chamber policy.

The transport group decided that monopolistic control of United States international air services is not favorable to prompt and progressive aviation development or in the public interest and competition should be controlled and maintained by reasonable government regulation as provided by existing law. An outstanding recommendation advocated by the Committee was ownership and operation of airplanes by steamship companies. Specific recommendations follow:

No Obstacles

1. International air transport had begun to play an important part in our overseas commercial life before the war. This natural economic development has been greatly accelerated by the war experience and no obstacles should be placed in the way of a continued rapid expansion of our aviation industry.

2. Just as ocean shipping services to all regions of the world with which we have prospective trade and travel will be needed, in the same way our air transport communications with such regions will be necessary in the interest of national defense and foreign commerce. It is noted with gratification that the Civil Aeronautics Board has initiated studies of desirable and required international air routes.

3. The reasonable economic development of our international air transport over a wide network of international airlines will require the intensive cultivation of both passenger and cargo possibilities over each route.

Against Monopoly

4. Monopolistic control of United States international air services is not favorable to prompt and progressive aviation development or in the public interest. Monopolies tend to be followed by government ownership and operation, which we believe is repugnant to the most effective development of aviation. In order to prevent monopoly and its inevitable after effects and in order to obtain for our foreign commerce the most effective service, able to compete successfully against foreign air lines, competition should be controlled and maintained by reasonable government regulation as provided by existing law.

5. There should be a continuation of government control by certificates of convenience and necessity in order to avoid destructive competition.

6. If necessary to insure the desired development, subsidies should be granted to our international air lines by mail payments on the basis of existing law or otherwise.

7. Since ownership and operation of airplanes in international commerce by steamship lines may be found desirable, depending upon circumstances in particular cases, and since competing foreign steamship lines will probably render such air services, American steamship companies should not be precluded by law or general administrative ruling from doing the same.

Disposal of Surplus

8. The disposal of surplus war-built passenger and cargo transport planes and equipment for active flying should follow a plan generally similar to that recommended for the disposal of war-built ocean ships. An interdepartment board should be set up to handle such disposal. Any disposal plan should provide as much incentive as possible for the design and manufacture of new types and the maintenance of production capacity necessary for defense and commercial competitive purposes.

9. To facilitate the change from a war to a peacetime basis and to provide international services during the transition period, which will be so critical for our foreign trade, transport planes should, as rapidly as possible without impeding the war effort, be made available for operation on the most desirable international air routes.

Landing Rights

10. We favor the establishment by treaty of the right for commercial planes of all countries to land for fuel, repairs or emergencies. This right, which is called the right of commercial transit, does not include right to discharge or take on passengers or cargo which right, if granted should be on a basis of agreement with the governments concerned. It is understood that governments may wish to restrict flying over certain limited areas for reasons of military security.

Chilean Air Chief Would Import Planes

In the opinion of Lt. Gen. Manuel Tovarias Arroyo, chief of the Chilean Army Air Forces, it is more practical to import planes and parts from the United States than to build an aircraft factory in his country. General Tovarias stated in an AERO DIGEST interview that Chile has no factories and is not planning to build any in the near future. He concedes that repair work

(*Continued on page* 383)

AIRCRAFT INSTRUMENTS ARE *Tested* WITH MERIAM MANOMETERS

Official photograph, U. S. Army Air Forces.

Meriam Manometers checking air speed indicators in the Instrument Inspection Laboratory of the Inspection Section, Wright Field.

THE aircraft industry is one of the largest users of Meriam Manometers and associated test equipment.

They are extensively employed at Army air fields in the United States and Possessions for checking and testing aircraft instruments; and in industry for testing aircraft engines, fuel and vacuum pumps, carburetor and other accessories.

In the illustration are shown two Meriam "8-in-1" Manometers (A-338). They are direct reading Well Type Manometers, each with an eight-sided scale selector, permitting the selection of proper scale for particular aircraft instrument being checked. They are widely used in both laboratory and field. Ask for Bulletin 22 on this instrument or Catalog C-10 on general line.

THE MERIAM COMPANY

1951 WEST 112TH STREET — *Since 1911* — CLEVELAND 2, OHIO

MERIAM — THE INSTRUMENT PEOPLE

(*Continued from page* 381)
would logically be done in Chile and that a large plant at Los Cerillos Airport, near Santiago, has been provided for this purpose.

Chilean Air Arm

General Tovarias, on a visit here to view U. S. Army Air Forces installations, related that the present air organization in Chile dates from 1930 when the Army and Navy air arms were fused and placed under the direction of a "General of the Air". Since then, personnel and equipment of the two forces have been closely cooperating with the thirty-six civil air clubs in training several hundred pilots who are now reserve officers of the Chilean Army Air Forces. Members trained in privately owned or club-owned planes.

Geographical Position

"Because of our geographical position", the visitor observed, "we are ideally situated to act as guardians of hemisphere security against any Eastern aggressor. Our coast line is long and can best be guarded by planes."

About Chile's post-war air aims, he said, "After the war, when Chile shall have facilities to acquire American planes, we shall develop our own commercial aviation and extend our domestic lines to form a large net extending from the tropical mining zones of the Peruvian frontier to the frozen steppes of the Straits. Our dream is to have all cities and towns of Chile interconnected by means of the airplane".

The General was accompanied by Brig. Gen. Oscar Herreros Walker, chief of staff; Col. Edison Diaz Salva, chief of the matèriel section; and Maj. Javier Undurraga Vergara, secretary to the chief—all of the Chilean Army Air Forces—and Col. Omer O. Niergarth, USAAC, who has been acting head of the United States air mission to Chile.

645 U. S. Planes Lost in 6 Months Over Europe

The Britain-based 8th Air Force of the AAF has lost 645 planes in the last six months' bombing raids over Europe, according to information compiled by a United Press correspondent. This amounts to approximately $150,000,000 worth of warplanes. Of this tally 553 were heavy bombers—*Fortresses* and *Liberators*—representing a total value of nearly $140,000,000; 69 were *Thunderbolt* fighters, adding some $5,500,000 to the economic side of the account; 23 were *Marauder* medium bombers, costing about $3,500,000.

Not included in these figures are the cost of training more than 5700 pilots, navigators, bombardiers and gunners who were casualties in the raids; nor the outlay for gasoline, bombs and ammunition, or for planes scrapped because of battle damage or training crack-ups.

In the same six-month period the RAF is reported to have sustained losses of 1388 heavy bombers.

Neither the 8th Air Force nor the RAF have disclosed the specific number of planes in all operations, but a recent disclosure intimates that the United States is planning to multiply the number of *Fortresses* and *Liberators* based in Britain.

Both services have lost less than the five percent which is regarded as the safe daily operating average. Such startling departures from the established pattern of losses as that recorded in the recent raid on Schweinfurt, Germany, are readily explicable.

The 60 heavy bombers lost in that instance, out of an attacking force of some 400—bringing the rate up to 15% — must be weighed against the fact that the target, three plants which had been accounting for half of the Reich's ball and roller-bearing production, "are now entirely inactive."

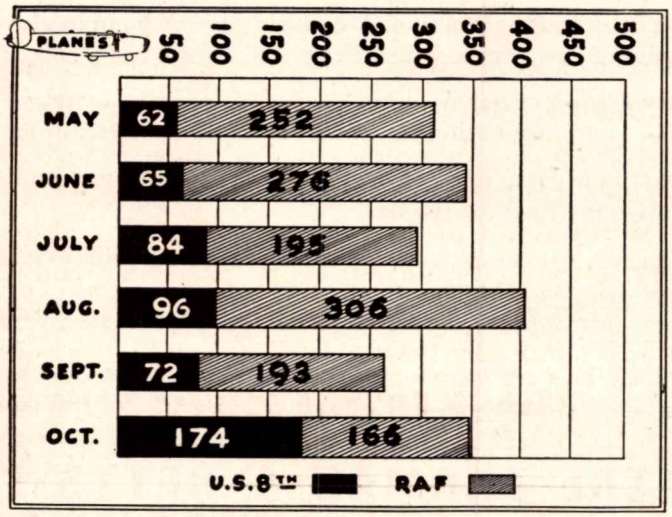
Consolidated's largest and smallest models of military aircraft, the "Liberator" and the "Flying Jeep". The jeep, produced by the Stinson Division at Wayne, Mich., weighs only one ton while the "Liberator", made in Fort Worth and San Diego, is a 28-ton airplane

Chapline Cleared of Wright Charges

George F. Chapline, who for a part of 1940 was vice-president in charge of sales of Wright Aeronautical Corp., has been completely exonerated in connection with the fraud charges brought against that corporation and certain of its officers by the U. S. Government, as an outgrowth of the report of the Truman Committee regarding alleged irregularities at the Lockland, Ohio, plant of the corporation.

Chapline, now a Commander in the U. S. Naval Reserve, established to the satisfaction of the courts that he was in no way connected with the acts complained of, having left the employ of the Wright Corporation on November 12, 1940, whereas the Truman Committee report shows that production did not begin at Wright's Lockland plant until late in 1941. It was also established that on leaving Wright, Chapline became executive vice-president of Brewster Aeronautical Corp., which has no connection with Wright. He remained with Brewster for two and one-half years, or until going into the Navy in July of this year.

[AERO DIGEST is glad to acquaint its readers with the courts' exoneration of this well-known and respected aeronautical executive to whom serious injustice has been done by the bungling tactics of public officials—Ed.]



How losses of Britain-based U. S. 8th Air Force compare with those of RAF. Rates of loss are well below average safety margin

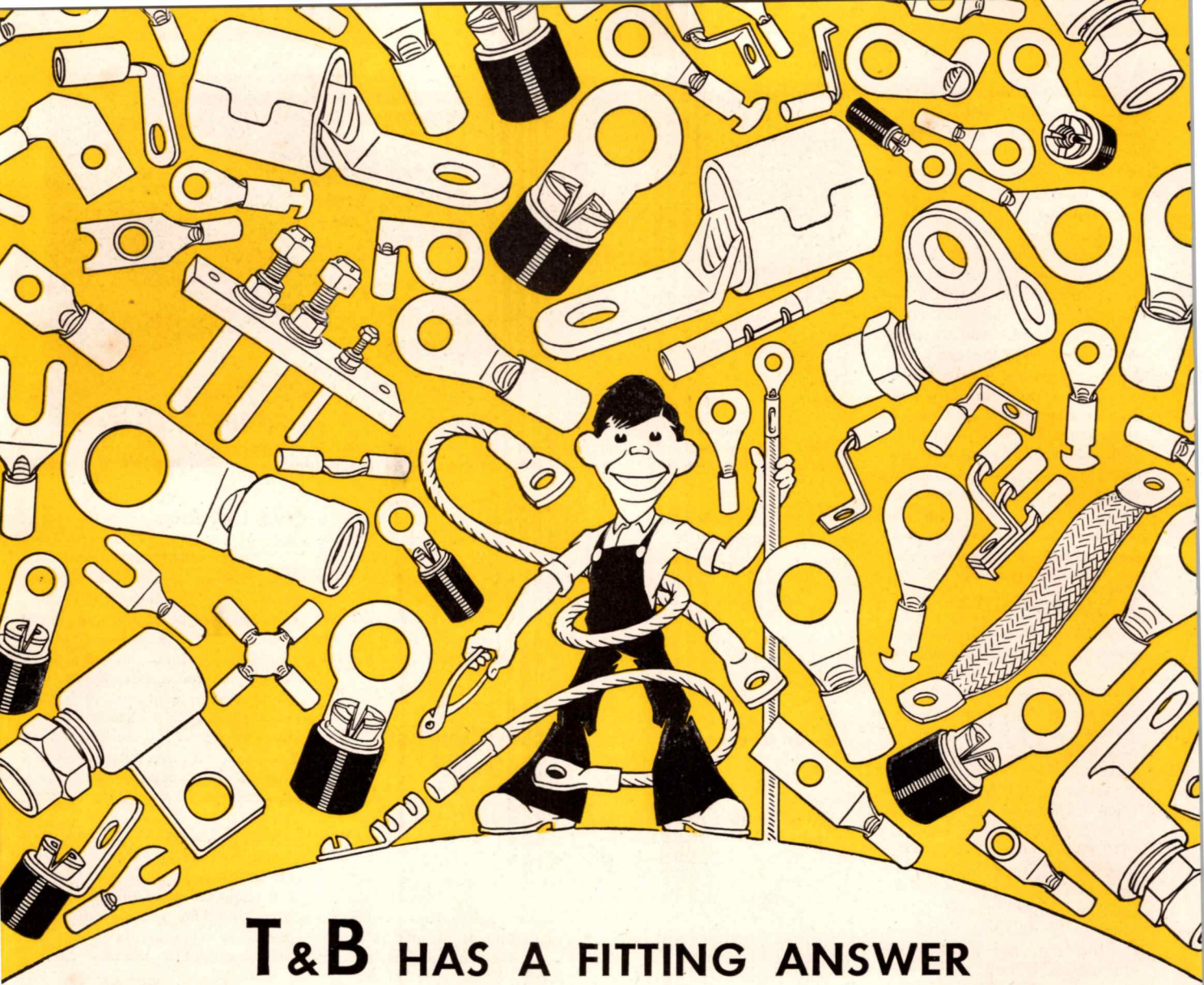
P-38 Output to be Doubled —Other Production Changes

Simultaneously with the recent announcement by an Air Forces spokesman that output of P-38 *Lightnings* would soon be doubled, the Office of War Information released data on this and other warplanes whose production is to be either stepped up or discontinued altogether.

Lockhead Aircraft is converting its entire facilities to the manufacture of the *Lightning*. The OWI reports that this plane has been given greatly increased horsepower, better pilot's vision and improved intercooling for better high-altitude performance. The F-5A, a version of the P-38, is being used by the AAF for photographic reconnaissance.

Already in production and scheduled for entry into combat by the spring of 1944 is a considerably larger and more potent bomber which will eventually replace the B-17, at least in long

(*Continued on page* 385)



T&B HAS A FITTING ANSWER FOR EVERY AIRCRAFT WIRING PROBLEM

HERE ARE a few of literally hundreds of T & B Pressure (Solderless) Terminals and Connectors designed to meet specific requirements of the various aircraft producers, and the manufacturers of electrically wired components, accessories and instruments.

From the beginning of aircraft production, T & B has worked hand in glove with the industry. We are constantly developing new, time-saving fittings—answers to faster and faster production prayers.

Write us for the new edition of our Aviation Catalog. It gives you engineering details, as well as complete T & B Tool and installation information on all our Aircraft fittings.

Along with all War industries, our production is at an all-time high. We are shipping, *on schedule*, many thousands of items each day.

However, because it takes just as long to procure the critical materials to make little parts as to make big ones, we suggest that you adopt this simple way of protecting *your own* production schedules. Order all small but essential production parts, like T & B fittings, at least four months ahead.

Under the T & B Plan the Electrical Wholesaler is our sole Distributor for these and all other T & B products. He reduces the manufacturer's selling costs, thereby reducing the cost of all electrical material to the user.

THE THOMAS & BETTS CO.

INCORPORATED

MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899

ELIZABETH, NEW JERSEY

In Canada: Thomas & Betts Ltd. Montreal

(*Continued from page* 383)
range operations. Recently the bomber has been identified as the B-29 by the Army weekly newspaper *Yank,* in an article which described it as "a new super fortress which will have a greater bomb capacity and longer range than any existing bomber." Gen. H. H. Arnold, commander of the AAF, introduced a portentous conception of the new bomber as the forerunner of a trend toward super bombers when he declared that the *Fortress* and the *Liberator* may become "the last of the *small* bombers."

The Bell P-39 *Airacobra,* is being supplanted by a new model now under construction. The greatest efficiency of the P-39 has been below 15,000 ft. The new model, with a low-drag wing and a two-stage Allison supercharged engine, will be efficient at any altitude up to 38,000 or 40,000 ft. Like the P-39, the new design will be equipped with a cannon in addition to machine guns.

Fewer "Marauders"

Also announced by OWI was the fact that the production of the Martin B-26 *Marauder,* is being tapered off. With all consideration for its high speed, good load capacity and excellent combat performance, reasons given for the tapering off are: conformity with the Air Forces' policy to reduce the number of models, concentrating production on highest performance types in each combat classification; the fact that the B-26's performance with one of its two motors shot out is not as good as that of a B-25 *Mitchell;* the plane's high landing and takeoff speed, which precludes its use out of smaller airports; and its relatively more difficult maintenance characteristics. Changing tactical demands also entered into the decision to use trained Martin personnel and factory space for production of more urgently required bombers.

RCAF photo

While a beach in British Columbia was being graded, engineers lay steel mats for a mile-long runway to be used by the RCAF. With carriers maintaining a steady flow of steel the job was completed in 13 days

Wings Club Honors Admiral Davison

The Wings Club, New York, was host at a dinner given in honor of Rear Admiral Ralph E. Davison, assistant chief of the Bureau of Aeronautics of the Navy Department, on October 28. Admiral Davison spoke on naval aviation in World War II.

Caleb Smith Bragg

Caleb Smith Bragg, well-known in the aviation, automobile and motorboat fields, died in New York October 26, after a long illness. He was 56.

Engineer, inventor and co-inventor of many automotive devices, including the Bragg-Kliesrath brake designed by him and the late Victor W. Kliesrath, Bragg had been associated with the aviation industry since 1915 as pilot, executive and consulting engineer.

Bragg first won fame as the automobile racing driver who defeated Barney Oldfield, and won many trophies in this country and abroad.

In 1912 he set a world automobile record of five miles in 3 minutes 11¾ seconds, and in 1912 he won the Fourth International Grand Prix race at Wauwatosa, Wis.

Learning to fly in 1915 he invested in the Glenn L. Martin Co. and became vice-president. In 1916 he acquired the Aero Club of America's Certificate No. 70. By the summer of 1917 Bragg had set American altitude records by reaching 21,000 ft.

At the outbreak of World War I he became an Army captain and test pilot at McCook Field, Dayton, and later was made director of flight activities at the field.

In 1918 he established a speed record from Dayton to Washington, D. C., of 2 hrs 50 min, and the next year set an altitude record for seaplanes by reaching 20,000 ft. He served as governor of the Aero Club of America in 1920-24.

After the war he was a director of Wright Aeronautical and president of the Bragg-Kliesrath Corp., subsequently absorbed by Bendix Aviation. Bragg served as a director of this company and later was vice-president of Bendix Marine Products. Bragg's last position was as vice-president and consulting engineer for C. M. Keys Aircraft Service. This he resigned last March because of ill health.

He was an Early Bird and also was president of the Wings Club of New York.

Buick Completes 25,000th Engine

The Buick Division of General Motors last month delivered its 25,000th Pratt & Whitney airplane engine and is currently manufacturing engines at the rate of well over 3000 per month. The first of these engines was delivered in January, 1942.

The Buick plants in Flint, Mich., and Melrose Park, Ill., are building the 1200 hp engines, four of which type power the Consolidated *Liberator.*

Although present engines are being produced at the lowest ratio of productive man hours per horsepower in the history of aviation, it is said that an increase of 25% is possible through new methods and improved tooling, according to president Harlow H. Curtice.

Still expanding its payrolls, to keep pace with its growing manpower needs, Buick today has three times as many workers as were employed in 1941.

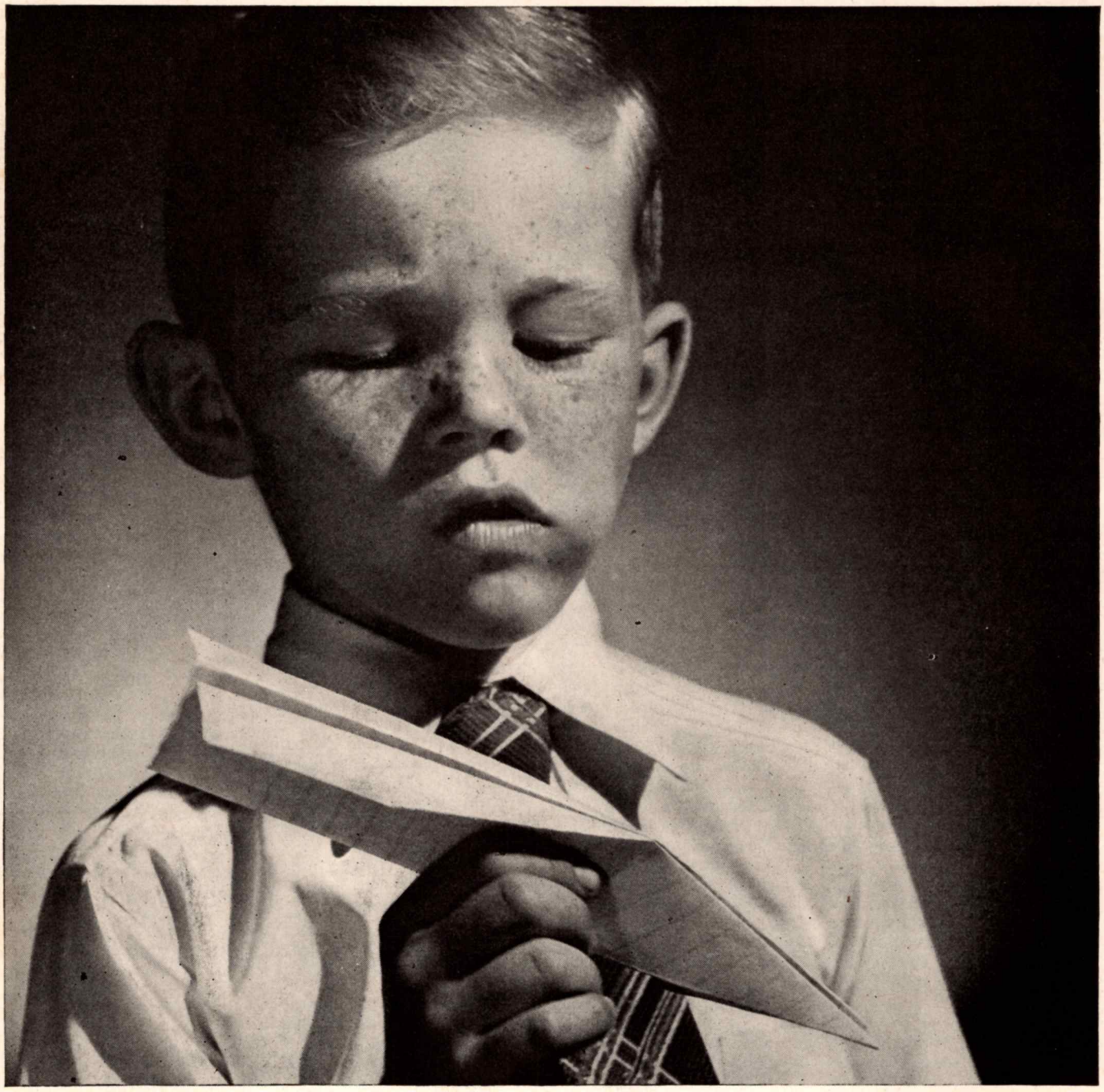
"Commando" Output to be Increased

Output of C-46 *Commandos* is today on a basis which will top any previous rate of production, according to the new schedule set up by Curtiss-Wright's airplane divisions and Higgins Aircraft, in cooperation with the Army Air Forces.

Plants designated to build the C-46 are the Curtiss-Wright plants in Buffalo, St. Louis and Louisville, and the Higgins factory near New Orleans. As prime contractors Curtiss-Wright will build complete airplanes.

The Louisville plant will produce outer panels for the St. Louis plant in addition to manufacturing sufficient panels for its own requirements. Higgins will supply outer wing panels for *Commandos* produced in Buffalo.

"Commandos" being assembled in Buffalo plant of Curtiss-Wright are shown in three stages of construction. First final details are handled on line at right, middle is advanced stage before transfer to line at left where planes are finished



GROUNDWORK

Remember the plane you made from copybook paper and sent sailing up the aisle—right on teacher's desk . . . and how surprised you were to discover the supporting power of the invisible air around you? A little paper plane has been "first flight" experience for many of us—our initial introduction to a science destined to serve mankind and make neighbors of all the world's people.

With the war's end, this high ideal of aviation will be revealed. *Aviation will belong to everybody.* Even today, in war-busy aircraft plants, the plane you will fly tomorrow is taking form. A lot is known about its design, a great deal about its flying simplicity. Its economy of operation and moderate price is already taken for granted. Fleetwings is anxious to get that plane to you. That's one of the many reasons why Fleetwings is working so hard for victory.

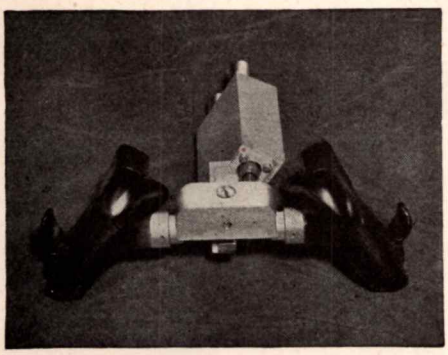
Plant No. 1

FLEETWINGS

Division of Kaiser Cargo, Inc.
BRISTOL • PENNSYLVANIA

FLEETWINGS

pioneers with parts and hydraulic equipment



Fleetwings B2 J2 Gun Turret Valve

THE EXPRESSION "Production keeps rollin'," is true in more than one sense at Fleetwings for the mobile production lines that Fleetwings pioneered for producing parts are now being extended. Parts in process of assembly are moved along on wheels. This system makes it easy to move them from one line to the next and does away with the need of hoists and extra factory hands.

AUTHORI Not entirely satisfied with available text books, Fleetwings is now preparing its own instruction books for its employee training. Instruction book number one, on the subject of drilling, is published, and already others are on the presses. In all, Fleetwings expects to supply its classrooms with at least five. These books, tailor-made for Fleetwings production, will improve efficiency.

In one issue of "The Arrow," Fleetwings' pocket-sized monthly magazine, the reader is treated to this varied fare of timely and interesting subjects: pre-doping of wing surfaces, case hardening tools to speed production, vertical lofting boards that save plant space, illustrated news about Fleetwings' personnel, how to make a wing chord divider beam, and an introduction to a newly designed hydraulic valve.

You can enjoy "The Arrow" each month at no expense. Just send your request on your company stationery to "The Arrow," Fleetwings, Bristol, Pa.

FLEETWINGS

Division of Kaiser Cargo, Inc.

BRISTOL • PENNSYLVANIA

Demarest Manages Wright Plant

John M. Demarest, consulting and plant engineer for the past quarter century and recently in charge of the War Production Board's aircraft plant expansion program, has been made plant manager of Wright Aeronautical units in the Paterson, N. J. area. He joined Wright eight months ago as assistant to the general superintendent. In his new capacity he will direct production of *Cyclone*-9 and -14 engines.

Demarest was closely identified with the physical expansion program of International Business Machines Corp. at Endicott, N. Y., where he served as plant engineer from 1932 to 1941. In his plant expansion work with the Government he handled as many as 53 projects at one time, including construction of one of the latest factories built by Wright.

Auto Industry's Aircraft Products Output in Billions

The auto industry has produced more than $4,000,000,000 worth of airplanes, engines and aero equipment since its facilities were converted to expedite warplane production. This compares with the industry's all-time car and truck production peak of $3,703,000,000 in 1941. In a "third anniversary" review, by the Automotive Council for War Production, of the motor industry's wartime participation in aeronautical manufacturing, it is revealed that one-quarter of the 4-billion total was completed during the first two years of the program, while production was doubled in the past twelve months.

Delivery of aircraft units is at the rate of $11,000,000 a day—from 1038 plants located in 31 states—and the rate is still climbing. Matched against the aviation industry's own production, automotive plants in the last twelve months accounted for nearly twice as great a dollar volume, as did the aviation group in the pre-Pearl Harbor months of 1941.

"E" Awards

For excellence in war production the following companies have recently been given the Army-Navy "E" award:

E. I. du Pont de Nemours & Co., plant of the Plastics Department; Arlington, N. J.

Link-Belt Co.; Caldwell, N. J.

Phillips Packing Co.; Cambridge, Md.

John M. Demarest, now directing plant activities for Wright Aeronautical at Paterson, N. J.

Star Awards

Winning Army-Navy recognition a second time, for meritorious services in war production, which qualifies them to add a white star to the "E" flag, are the following companies:

Clarostat Mfg. Co., Inc.; Brooklyn, N. J.

Greenfield Tap & Die Corp.; Greenfield, Mass.

Lodge & Shipley Machine Tool Co.; Cincinnati, Ohio.

Sprague Specialties Co.; North Adams, Mass.

Thomas & Betts Co.; Elizabeth, N. J.

Wagner Electric Corp.; St. Louis, Mo.

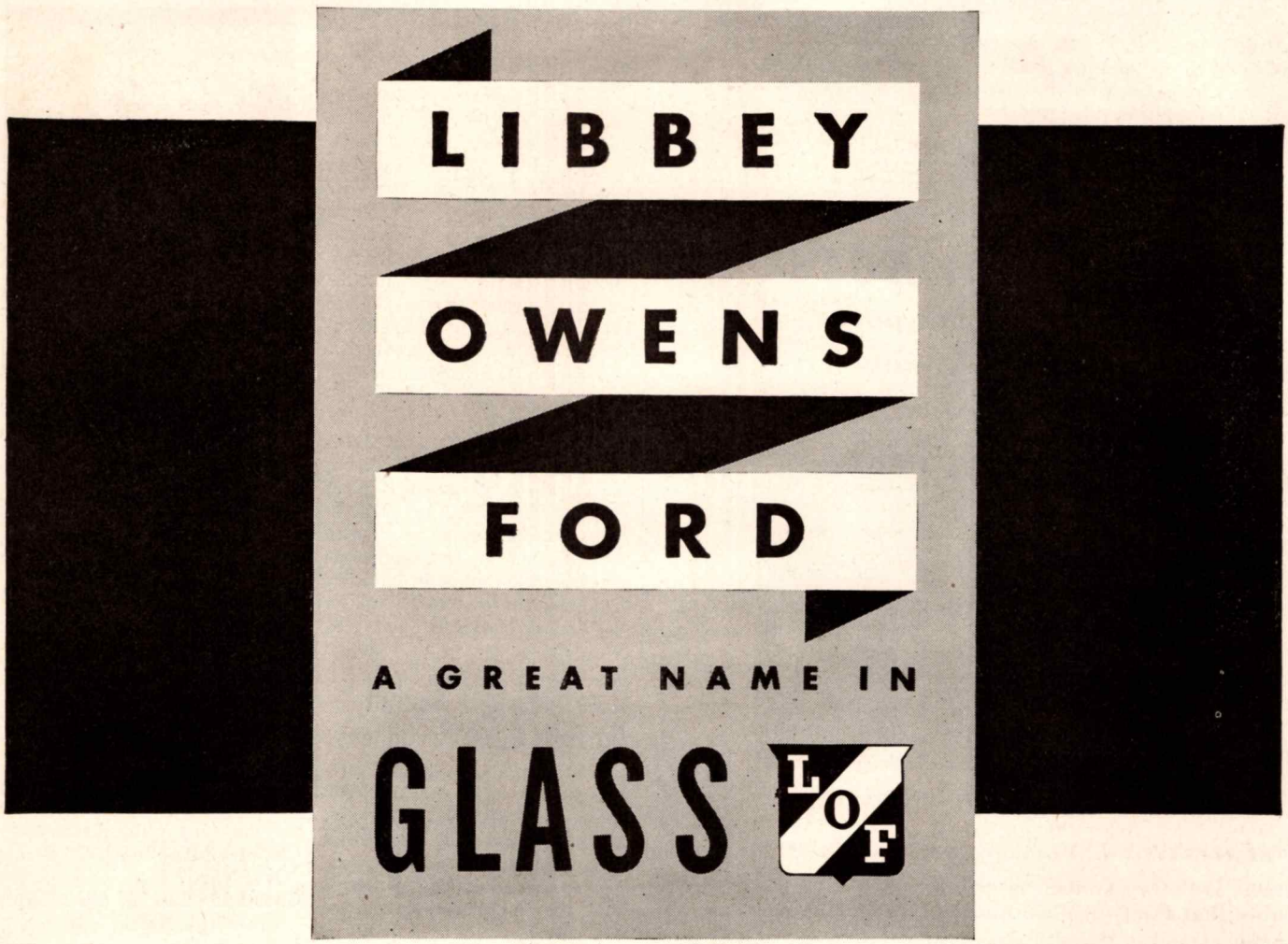
Westinghouse Electric and Mfg. Co.; Derry, Pa.; East Pittsburgh; Elevator Company plant, Jersey City, N. J.; Manufacturing and Repair plant, Newark, N. J.; Manufacturing and Repair plant, Philadelphia, Pa.; Nuttall, Pa.; Steam Division, South Philadelphia, Pa.; Trafford, Pa.; and Transformer Division, Sharon, Pa.

Pacific Aviation Trio Acquitted

Three officials of Pacific Aviation, Inc., have been acquitted of the charges of conspiracy to defraud the Government in connection with overtime payments on a Navy contract. They are Patrick J. Brady, general manager and secretary-treasurer; Walter M. Jameson, vice-president and William H. Young, comptroller.

Last April these men were indicted on three counts of con-

(*Continued on page* 389)



For many years the name Libbey·Owens·Ford has stood for Quality and Service in every field in which glass is used. Today, our government and the armed forces of the United Nations on land, sea and in the air have first call on our products and services, our Production and Research facilities and our Engineering developments — many of which have been converted to the highly specialized work required in the aviation field.

On the civilian front, Libbey·Owens·Ford products are being used in an ever-widening circle of applications — not only for their normal functions, but to replace those more critical materials demanded for the war effort. After the war, the familiar L·O·F Trade-Mark will have even greater significance to the glass users of America. Libbey·Owens·Ford Glass Co., 71113 Nicholas Building, Toledo 3, Ohio.

Manufacturers of Clear Vision Window Glass, Thermopane, Polished Plate Glass, Tuf-flex, Golden Plate, Vitrolite, Vitrolux, Thermolux, Bent Glass, Glastone, Heat Absorbing, Optical and many other decorative and specialty glasses.

(*Continued from page* 387)
spiracy to defraud the Government. Two counts were dismissed early in the trial; the jury was out only 5 hours before returning its verdict on the third count. Defense attorneys argued that the confusion of wartime efforts caused records to become jumbled, and that actually the sum of $43,534, charged the Government in connection with the manufacture of tools and parts for naval aircraft, is more than offset by a $60,000 item due the company.

SAE Air Cargo Meeting

An engineering preview of the post-war air cargo field is the theme of the Air Cargo Meeting of the Society of Automotive Engineers to be held November 8 and 9 in Chicago. The speaking program follows:

Some Economic Aspects of Commercial Use of Converted Military Aircraft—E. C. Wells, Boeing Aircraft Co.
Design Considerations of the Cargo Airplane — Carlos Wood, Douglas Aircraft Co.
The Use of Air Freighters in Areas Not Served by Other Adequate Means of Transportation in Northern Canada—W. L. Brintnell, Aircraft Repair, Ltd.
Payload vs. Operating Speeds—J. C. Borger, Pan American Airways System.
Basic Fundamentals for Packaging Air Cargo Shipments—J. H. Macleod, Hinde & Dauch Paper Co.
Air Cargo Handling Equipment Design Consideration—H. W. Anderson, Whiting Corp.
Coordinating Air and Surface Transportation—Prof. John H. Frederick, University of Texas.
The Characteristics of Air Cargo Transportation—E. J. Foley, American Airlines.
The Helicopter and Direct Lift Craft—W. B. Stout, Stout Research Laboratories.
The Potential Air Cargo Market—William A. M. Burden, special assistant to Secretary of Commerce.

New Trade Channels Opened in Mexico

Herman Yaras, head of a Los Angeles importing and exporting firm, who recently completed business arrangements with Mexargo, Mexico's largest trading house, announces the opening of new trade channels in that country. With its headquarters in Mexico City, Mexargo maintains distribution facilities throughout Latin America.

Yaras, on returning from a two month sojourn there, reports that: "Mexico wants and needs American products as quickly as possible, especially those which will fit in their big industrial and agricultural development program now well under way."

Formerly president of the Marsman Trading Corp., in the Philippines, Yaras is well known in foreign trade circles.

Hamilton Prop Output Increased 24-Fold

Production at Hamilton standard Propellers division of United Aircraft has increased more than 24-fold since September 1939, according to Sidney A. Stewart, the division's general manager. By the beginning of next year it is expected to reach a rate 60 times that recorded at the start of World War II.

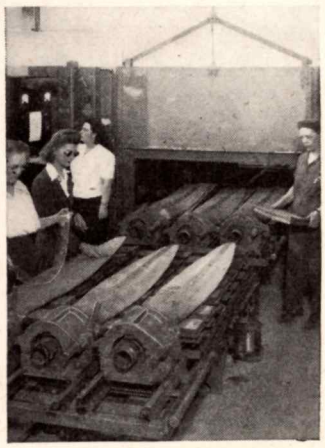
In 1939 Hamilton turned out 1,666,191 lb of aircraft propellers, representing the largest production by a single manufacturer in the world. Present production is being accomplished with less than seven times the pre-war manpower and less than five times the 1939 factory space.

With its licensees the company is today producing more than 76% of all American warplane propellers and supplying more than 30 major types of Army and Navy planes.

Embry-Riddle Opens Brazilian School

The Embry-Riddle School of Aviation has signed a contract with the Brazilian government to establish and operate the Technical School of Aviation of the Brazilian Air Ministry at Sao Paulo, Brazil. The contract was drawn up following a visit to the institution by Brazilian Air Minister Joaquin Pedro Salgado Filho.

With operations starting the (*Continued on page* 391)



400,000-volt X-ray "studio" of American Propeller, subsidiary of the Aviation Corp., is fully automatic in its operation after the conveyors have been loaded with propellers, taking a required nine negatives of three completed blades in the same time formerly needed for one blade

Announcing

NEW

hi-g
TRADE MARK

TEMPERATURE CONTROLS FOR AIRCRAFT

Our engineers have perfected a new line of *hi-g* temperature controls for operating flaps on airplanes.

Operating hydraulically, these controls give instant, automatic response on either liquid or air cooled motors.

The efficiency and reliability of the new *hi-g* controls have been proven by exhaustive tests on both commercial and combat planes.

These new controls not only reduce the human element in plane operations but retain all the *hi-g* advantages. They operate in any position, regardless of vibration, change of motion or acceleration.

This new line offers equal advantages to the designer and manufacturer of post-war aircraft. We invite your inquiries. If you have a temperature control problem, write us.

GENERAL CONTROLS

Wartime Manufacturers of Electro-Magnetic and Temperature Controls for Aircraft • Peacetime Producers of Automatic Pressure, Temperature, and Flow Controls

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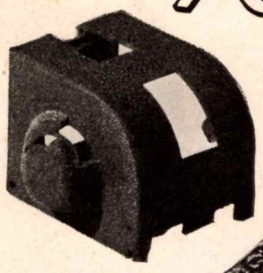

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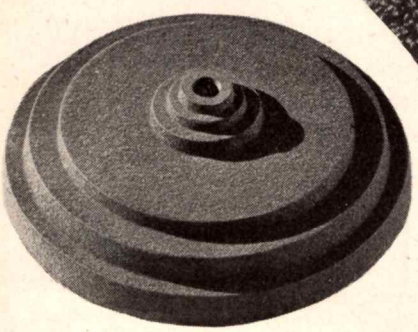
WRINKLE ALAKA FINISH

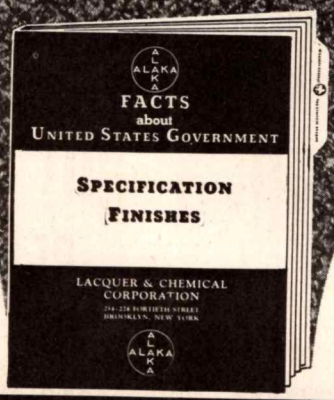
- It offers a desirable and uniform wrinkle formation.
- It is applied with the same ease and speed.
- It may be baked at 300° F for 1 hour.
- It may be baked with infra-red lamps.
- It bakes hard in very little time.
- It has great mileage in terms of coverage.
- It covers rough metal surfaces in one coat.
- Try it . . . . Use it . . . . Request a sample.

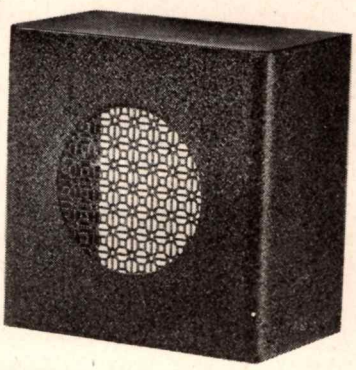
Submit Your Finishing Problems to the ALAKA TECHNICAL DEPARTMENT

- New, Complete, Up to the Minute Catalogue of U. S. Government Specification Finishes

Send for your copy







LACQUER & CHEMICAL CORPORATION

214-224 FORTIETH STREET • BROOKLYN 32, N. Y.

(*Continued from page* 389)
rst of this month, about 500 tudents are expected to be en-olled by the end of December. On completion of a six-month pecialized course, the graduates ill be assigned to various posts n the Air Ministry.

Headed by James E. Blakeley, echnical director of Embry-Rid-le, a staff of one hundred in-tructors in addition to other per-onnel will be at a nearby air-ort on which construction will e completed within six to twelve nonths.

Legislation Needed to Speed Contract Terminations

Procedure in cancellation of war contracts was discussed by Col. Bryan Houston, general staff corps, U. S. Army, speaking at a meeting of the Aircraft Parts Manufacturers Assn. in Los Angeles recently. The gathering was attended by representatives of fifty leading airplane parts manufacturers.

Referring to the problem faced by manufacturers of aircraft parts who have to wait for settlement through prolonged delays, a subject broached by T. T. Arden, president of the association, Colonel Houston stated that legislation would have to be passed by Congress to expedite war contract settlements with a minimum of delay and investigation.

Describing the War Department's attitude, he added: "We have asked for permission to give you 90% of the cost as soon as you can determine that cost, and we want the law to provide that if we have overpaid you, you owe the government that over-payment plus six percent."

Colonel Houston has been made deputy administrator of rationing for the Office of Price Administration, on "lend" arrangement with the Army.

Aviation Distributors to Meet in December

Aviation Distributors and Manufacturers Assn. has chosen St. Louis, Mo. for its first annual meeting, December 1, 2 and 3. The meeting is being held concurrently with the annual meeting of NATA, also in St. Louis.

On December 2 a joint service clinic will be participated in by operators, distributors and manufacturers who will discuss maintenance and overhaul problems. In preparation for the clinic ADMA conducted a pre-convention conference this month in New York City.

Amsco Pools War Efforts of Three Concerns

Three of the nation's oldest aviation concerns have come together to form an organizational unit for the purpose of coordinating their parts in the war effort. The involved companies are Pacific Airmotive, identified with airplane and engine overhaul work since 1927, Airplane Parts & Supplies, distributors of new and reconditioned aircraft parts for the past ten years, and the Manufacturing Division of Airplane Mfg. & Supply Corp. The last mentioned name having been adopted by the group, the managing company will operate under the trade name of AMSCO.

Earl Herring, president and general manager of newly organized AMSCO group

Serving as president and general manager of AMSCO is Earl Herring. Other officers are Edward O. Locher, assistant general manager and secretary and treasurer; Ralph B. Lacoe, vice-president, and K. R. Jamison, vice-president in charge of sales.

Bowser Changes Name

Effective September 16, S. F. Bowser & Co., Inc., assumed the new name of Bowser, Inc. There was no other change accompanying this one, in the corporate status.

Continental to Build "Merlin" Engines

Continental Aviation and Engineering Corp., Muskegon, Mich., has been designated by the War Department to manufacture the Rolls-Royce *Merlin* engine. Production of this unit will go into effect early in 1944. At

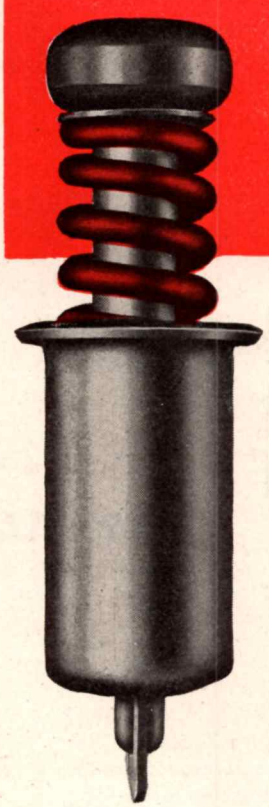
(*Continued on page* 393)

★ ★ ★ ★

BELL AIRCRAFT TESTED
LOXIT SKIN FASTENERS

PHOTOGRAPH COURTESY BELL AIRCRAFT CORP.—SHOWING ACTUAL APPLICATION

FOUND THEM SAFER, FASTER, EASIER TO USE...



Test it . . . as Bell did . . . you too will find it worthwhile

THE LOXIT SKIN FASTENER . . . was recently tested by laboratory technicians at Bell Aircraft, makers of fast P-39 Airacobras, and *found to fulfill all our claims.*

SAFER . . . A higher safety factor, specially appreciated by women workers, is assured by special design and rugged construction. Hardened steel body shell and heat-treated plunger reinforced by tubular sleeve, mean long life and economy as well.

FASTER . . . LOXIT Skin Fasteners need to be compressed only at moment of application. Motion studies show that the resulting 75% saving in worker-fatigue speeds skin fastening by 10%.

EASIER TO USE . . . Simply line up skin holes, using fastener's tip as guide. Compress the fastener, and — snap! — it's in. Being smaller, LOXIT Skin Fasteners are also easier to handle at close quarters, especially near right angle bends.

FREE SAMPLES

A request on your business letterhead will bring you LOXIT Skin Fasteners for your testing. You'll find it fits any standard type pliers or gun. Write today. Scovill Manufacturing Company, 21 Mill Street, Waterbury, Connecticut

LOXIT SKIN FASTENERS SPEED THE JOB
... A SCOVILL PRODUCT

No danger of dinging thin skins with this rivet set!

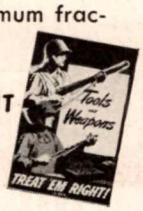
ACTUAL SIZE

An oversize Microglass finished face (2½" in diameter) plus light weight enable this new type Aero Tool Flush Set to do the difficult job of riveting thin skins *without dinging* Even in the hands of unskilled labor, the extra large face on this set reduces rejects and speeds flush riveting operations.

Forged from tool steel and heat treated according to the latest metallurgical methods, the even grain flow of this flush set has terrific impact resistance and minimum fracture possibility. Aero Tool's exclusive Microglass Finish imparts a mirror-like, ultra-smooth finish to the crown surfaces that protects thin skins from dents and abrasions while riveting.

Write, today, for catalog listing this and other Aero Tool Precision Products for better, faster riveting.

TOOLS ARE WEAPONS—TREAT 'EM RIGHT



AERO TOOL CO.

ENGINEERED AIRCRAFT TOOLS

231 WEST OLIVE AVENUE

BURBANK, CALIFORNIA • DEPT. AD11

(*Continued from page* 391)
present Packard Motor Car Co. is the principal maker of the *Merlin* engine in this country.

Continental will manufacture the latest version of the engine, redesigned for the two-speed, two-stage supercharger. This type increases the rating to over 1500 hp and adapts the engine to high altitude work.

Continental's Muskegon plant is now in volume production on the 650 hp Pratt & Whitney engine used principally in advanced trainers. Manufacture of this engine will be transferred to the company's plant at Garland, Tex. Continental's Detroit plant, which builds radial aircraft-type engines for tanks, will take on certain tank-engine subassemblies formerly completed at Garland.

Huge relief map of the Puget Sound country used in training classes of civilian defense aircraft warning service at Vashon Island, Washington

New Welding Control System Shown in Chicago

Shown publicly for the first time at last month's Metal Show in Chicago, the new P & H production welding control system is said to be a most important development in the direction of providing adequate control of the human factors influencing welding.

An "arc timer" employed in connection with the system shows the exact time spent in actual deposit of weld metal, as well as total idle and non-productive time. Visual records provide all the basic information necessary for complete and accurate control over costs, procedures, production and quality of all types of work, assuring the worker a fair rate of compensation in direct relation to his ability and energy.

Comparative studies and tests of actual applications by Harnischfeger engineers reveal the finest degree of control over all phases of welding fabrication when the system is used with base-rate-plus-premium compensation. The system's sponsors point out, however, that it can be applied to any of the three basic methods of compensation with increased benefits resulting to employers and employees.

Niles-Bement-Pond Buys Chandler-Evans

Niles-Bemont-Pond, a division of Pratt and Whitney, has acquired the entire stock of the Chandler-Evans Corp. in exchange for Niles treasury stock. Chandler-Evans, manufacturers of aircraft engine accessories, with plants located at South Meriden and Wallingford, Conn., and Dayton, Ohio, will continue to operate with the same management and personnel.

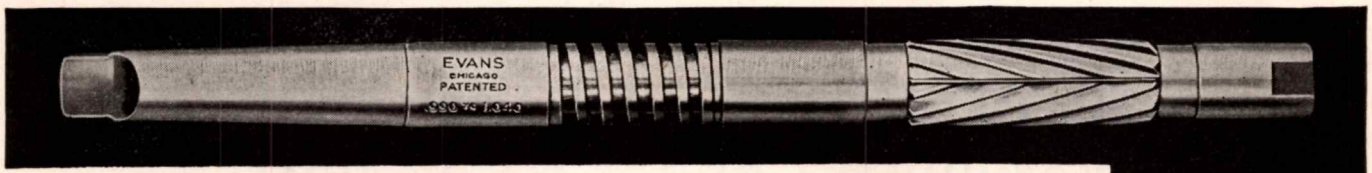
Clayton R. Burt is president of Niles. Charles W. Deeds will remain as head of the subsidiary company.

Oldsters Replace Youth

Aircraft Accessories Corp. has cut to 7% the number of draft-age employees under 25. The manning table program, put into operation May 1 when 40% of the draft-age men were 25 or younger, reduced the number to 24% by July 1.

Despite the release of so many to the armed forces, the level of

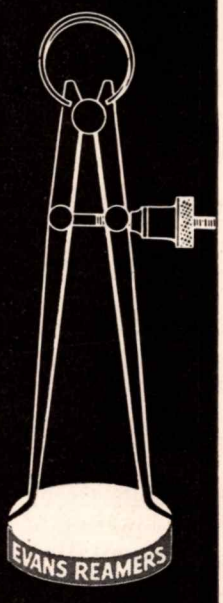
(*Continued on page* 395)



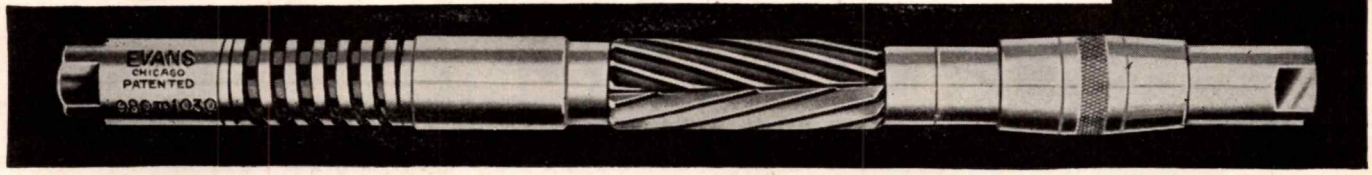
YOU'D THINK IT WAS BUTTER...

. . . instead of magnesium, bronze, aluminum, iron, or steel. That's how easy the same Evans High Speed Steel Expansion Reamer makes perfect holes in virtually any metal alloy. Three removable spiral blades cut in opposed directions at the same time, and ream smoothly, even over split bushings. Straight line expansion from .035" to .080" makes Evans Reamers last as high as 100 times longer than an ordinary one-piece reamer.

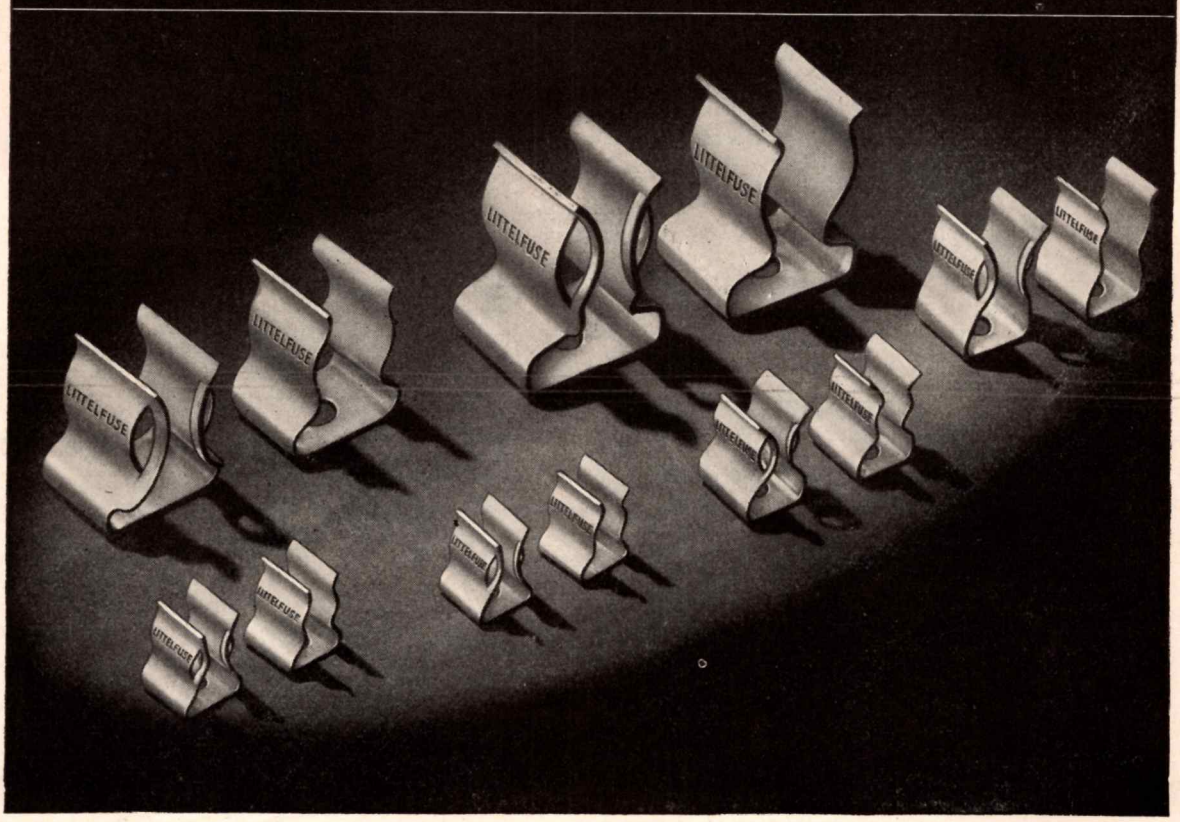
- ★ Eliminates Honing
- ★ Extensions and Pilots for Line Reaming
- ★ Nos. 1 to 5 Morse Taper Shanks Available
- ★ Butt Shank Available for Turret Lathe
- ★ Taper Bushing Available for Line Work



EVANS REAMER AND MACHINE CO.
4541 RAVENSWOOD AVE., CHICAGO, ILL.
Established 1918



New! SILVER-PLATED Fuse Clips AT NO EXTRA COST!



LITTELFUSE *Silver-Plated* Beryllium Copper Fuse Clips!

(Another Littelfuse improvement)

SILVER has the highest electrical and thermal conductivity of all metals. It has the lowest resistivity. Even the oxide of silver becomes a conductor. With silver-plating, Littelfuse Beryllium Copper Fuse Clips are brought to the greatest efficiency *in all factors.*

CONTACT RESISTANCE REDUCED APPROXIMATELY 20 PERCENT

Results for comparison have been obtained under severest conditions of actual service as well as many laboratory tests. Littelfuse *silver-plated* Be. Cu. clips consistently show this lowering of contact resistance, as against that of clean nickel or cadmium plating.

Oxides of all other metals are of high electrical resistivity. Silver plating practically eliminates the effects of oxidation. At extreme temperatures (300° C.) silver oxide film resolves, leaving a residue of pure silver. Silver sulphide, formed in high humidity, has much lower resistivity than sulphides of other metals.

ADDED TO ANTI-VIBRATION—STRENGTH—FATIGUE RESISTANCE

Characteristics of Littelfuse Be. Cu. Fuse Clips have long been familiar to engineers: extreme anti-vibration factor, high tensile strength, high modulus of elasticity, spring qualities equal to steel. Fatigue resistance is well above 40,000 p.s.i. Grip is triple that of the best phosphor bronze. Without silver-plating Littelfuse Be. Cu. Clips showed heat resistance up to 200° C.

Now with the use of silver their electrical conductivity is increased to the greatest practicable degree. Corrosion is no longer a factor. Extreme temperatures offer no problem. Strategic metals are conserved.

All Littelfuse Be. Cu. Clips are now silver-plated without extra cost to users, unless specifically ordered otherwise.

SEND FOR TECHNICAL BULLETIN

Full engineering data, drawings and tables on Littelfuse Be. Cu. Clips and Screw Terminals available on request. Write or wire

LITTELFUSE Incorporated

200 ONG ST., EL MONTE, CALIFORNIA 4757 RAVENSWOOD AVE.; CHICAGO 40, ILLINOIS

(*Continued from page* 393)
production has been maintained with women and older men trained to fill vacancies as they occur.

Curtiss Propeller Output at 59 Times 1939 Rate

Shipments of airplane propellers at Curtiss-Wright in the first nine months of this year were 59 times greater than in the corresponding period of 1939, according to Guy W. Vaughan, president.

At the recent annual meeting of stockholders, Vaughan stated that the corporation had produced 22 times as much aircraft engine horsepower as in the first three quarters of 1939; and that the airplane division had shipped 26 times as many pounds of airframes.

Plant floor space has been increased from 2,000,000 sq ft in 1939 to the current area of more than 23,000,000 sq ft, he said. Since the start of the war the number of employees have increased from 8,000 to about 180,000 with a labor turnover, last year, of nearly 50,000.

North Carolina Creates Aeronautics Commission

North Carolina's newly organized Aeronautics Commission has made its first report to Governor J. Melville Broughton in Raleigh following a survey of the state's aviation facilities, including schools and equipment. The commission, appointed by the governor, was authorized at the general assembly session recently.

Members pointed out, in their report of the state's airfields, that some of these would cease to have importance after the war while others will be expanded for use for interstate and intrastate commercial air transportation. Government aid to state airports was discussed and plans to raise necessary funds to support an agency to regulate all state airways were considered by the group.

Chairman of the committee is Roy Rowe, Burgaw, and members are: Ben Douglas, Charlotte; E. C. Brooks, Jr., Durham; William C. Olsen, Raleigh, and Lee H. Smith, Burlington.

Aeronautical Chamber Reorganized

The Aeronautical Chamber of Commerce of America has been reorganized in accordance with modifications voted upon by members recently. Under the new plans the number of members of the Board of Governors will be left as at present—fifteen—but hereafter one-third of this number will be elected each year.

In accomplishing this the next annual meeting will elect five governors for a term of three years, five for two years and five for one year.

In addition, the president and the chairman of the board, with the advice of a special committee, have been empowered to employ a chief executive for a period of up to three years.

The committee is composed of Guy W. Vaughan, E. E. Wilson, Donald W. Douglas, Dwane L. Wallace, J. H. Kindelberger and E. R. Breech.

Recommendations that a new name be adopted, and that membership be limited to manufacturers, will be submitted to a vote later.

Britishers Plan Youth Aviation Training

Two Britishers, Sir Bertram H. Jones of the Chairmen's Advisory Committee of the Air Training Corps and Councilman W. J. Taylor of the Yorkshire Training Corps Assn., have proposed plans for the participation of English youth in building up post-war aviation according to a recent issue of *Flight*.

They suggest the formation of a British Air Corps with groups in various parts of the Empire which may later be fused into one British Empire Air Corps. Their organization would include a senior division to which ex-Service personnel would be admitted, a junior division for pre-entry training of youths for civil aviation careers, and a preparatory division allied to and working with the existing Air Scout organization.

Such a corps, would, they believe, insure the availability of large numbers of skilled personnel to man an Air Police Force, Marine Air Patrols and an Air Territorial Force. For the latter the title British Empire Air Reserve is suggested. Its proponents maintain that although the organization must be attached to a Government Ministry for purposes of Parliamentary financial control, it should be administered by a civilian board.

Nation-Wide NASC Meeting This Month

The National Aircraft Standards Committee is holding its sixth nation-wide meeting in New York City, November 8 through 12, together with principal members of the Army-Navy Aeronautical Board, the Aircraft Re-

BRAKES THAT SAY... "Whoa" and MEAN IT!

Developed by Scott engineers to surmount certain disadvantages of light aircraft hydraulic brake systems, the improved Scott "B-711" Brake Pressure Unit brings unusual efficiency and dependability to braking operations. Quick response and positive action is assured at all times due to their special pressure-tight construction. Scott Pressure cylinders are designed for expander and other types of hydraulic brakes. Readily installed, and located with pedals in conventional relationship to the rudder pedal. These units are simple in design, durably built, light in weight (only 21 ounces). Each unit is exactingly tested. Economically priced. Write for illustrated folder.

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DESIGNERS AND MANUFACTURERS OF SPECIAL EQUIPMENT FOR THE AIRCRAFT INDUSTRY

BRAKE PRESSURE UNITS for Hydraulic Systems

DO YOU HAVE AN IDEA

for an airplane accessory or part for our engineers to develop?

We are looking for ideas for airplane accessories and parts, to be made of metal, which our engineers can develop for you now—and have ready for production when Victory is won.

Right now our extensive facilities are devoted entirely to the building of quality precision parts for America's fighting planes. Our engineering staff, however, is free at times to help develop your peacetime product. Inquiries by letter are invited from responsible parties.

BRUENING-WINANS
CORPORATION
Department AD113
ROCHESTER, NEW YORK

sources Control Office and Engineering Societies planning the National Standards program.

The first two days will be taken up by the business of the executive board, followed by a three-day general session. Officers for the past year have been Eric Dudley of Curtiss-Wright, national chairman; W. D. Craig of Grumman, eastern chairman, and Gordon Waite of Consolidated-Vultee, western chairman.

Boeing Hires More Employees

Employment has increased at Boeing's Seattle plant with over 2600 additional employees having joined the company since September. Of the total gain, 1785 workers were added to the Seattle division rolls, 509 to the Renton and 349 to branch plants.

More than 800 of the new *Flying Fortress* builders were recruited in other sections of the country by Boeing's out-of-state hiring teams, and an additional 950 persons have been signed up and will arrive in Seattle in the near future. Although the immediate labor shortage has now been eased, continued employment of the newcomers will be required to compensate for the normal turnover and for the long-range build-up of manpower.

Goodyear Reopens Pliofilm Plants

As a result of greatly increased war uses for *Pliofilm*, the Goodyear Tire and Rubber Co., resumed production of the moisture-proof thermoplastic packaging material at its St. Mary's, Ohio, plant. Another plant was opened in October, and a third the first of this month. At the same time manufacture has been stepped-up 10% in the Akron plants with improvements in processes.

Pliofilm's use for airplane engines eliminate approximately 75 man hours per engine by saving greasing and degreasing as well as providing protection. Prior to the beginning of the war the plants at St. Mary's had been shut down to conserve rubber, later being opened to manufacture fire-proof and moisture-proof canvas duck for U. S. Army tents.

Surplus Property Studied by U. S. Chamber

The United States Chamber of Commerce has selected twenty-seven representatives of varied lines of industry as a special committee on utilization of war plants and surplus property for studying post-war problems. Albert C. Mattei, a vice-president of the Chamber and president of the Honolulu Oil Corp., was named the chairman of the special committee.

At the first meeting of the group in Washington a preliminary survey of the scope and extent of the problem was made and an invitation extended to business men to submit to the committee phases of the problem that concern them.

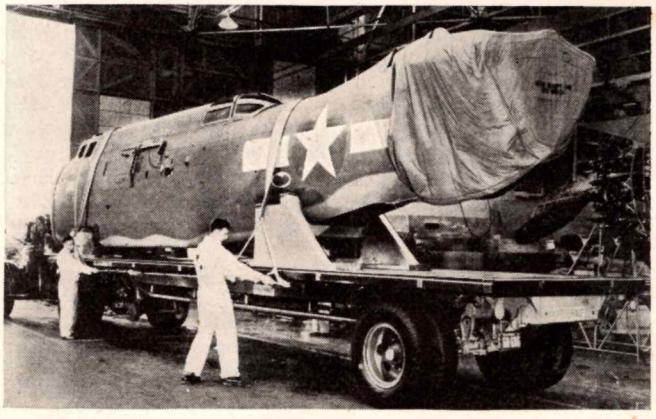
The purpose of the committee is to prepare for the utilization of the overstocked, obsolete materials that result from changing to new weapons, redesigned facilities and necessary changes of a highly mechanized war.

Members of the committee include officers of companies engaged in the manufacture of raw materials, war supplies, industrial machinery and transportation equipment, ships and distribution of consumer goods and banking.

Brown Made WPB Deputy Director

Richard P. Brown, chairman of the board of Brown Instru-

(*Continued on page* 399)



Truck-and-trailer facilities are being used by the aircraft industry to extend production lines from plant to plant and from city to city. This Fruehauf trailer, loaded with the fuselage of a patrol bomber, is an "assembly line on wheels"

Photograph courtesy Pan-American World Airways

. . . A SPECK OF DUST CAN CAUSE FLIGHT FAILURE

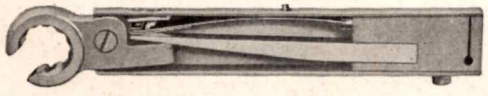
Hydraulic systems are the vital "life lines" of modern aircraft. Metal Tubing Seal-Caps and Seal-Plugs are now accepted as essential to the protection of hydraulic lines and fittings during *overhaul* . . . to *seal out* foreign matter . . . to help keep planes right for flight.

HOW PAN-AMERICAN PROTECTS HYDRAULIC LINES DURING OVERHAUL

Adherence to a rigid policy of *perfection with speed* in overhaul is one of the vital contributing factors to Pan-American World Airways' remarkable performance record. Hydraulic systems on these giant ships of the airways are *positively sealed* with metal Tubing Seal-Caps and Seal-Plugs during overhaul. No risk is taken that would allow one speck of dirt or dust, one minute drop of moisture, to enter. Pan-American's experience proves that metal Tubing Seal-Caps and Seal-Plugs are *essential in overhaul* to SEAL OUT all foreign matter . . . to SEAL IN all fluids that need not be drained during overhaul. For *maintenance* as well as *manufacture,* use these perfected guardians of vital hydraulic lines and fittings. Write for 32 page instruction manual on tubing fabrication and maintenance.

"Tools are weapons—treat 'em right!"

Seal-Cap *Seal-Plug* *Boss-Plug*



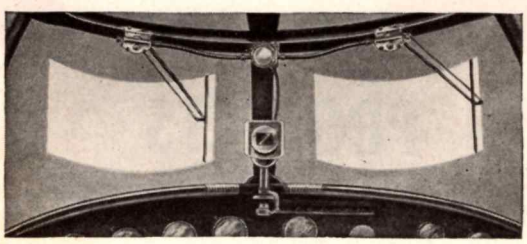
Ask for data on Livermont Torq-Stop Wrench, too.

TUBING SEAL-CAP, INC.

215 W. 7th ST., LOS ANGELES • EAST. REPR., 428 NEW CENTER BLDG., DETROIT

NO "Time Out" FOR RAIN

Marquette
All-Weather Windshield Wiper



● In the Pacific, we're keeping the enemy on the run—come good weather or bad. In time of rain, the Marquette Wiper gives our bombers the vital advantage of clear sight, the ability to see—in takeoff, in flight and in landing.

The Marquette

METAL PRODUCTS COMPANY
Cleveland, Ohio

Employes of Fleet Aircraft, Ltd., Fort Erie, Ontario, celebrate completion of their 1000th "Cornell" trainer, which they presented to the RCAF

(*Continued from page* 396)
ment and vice-president of Minneapolis-Honeywell Regulator Co., has been appointed deputy director of the War Production Board, Third Region.

Brown's new duties include maintenance of maximum production in plants engaged in war work and the coordination of efforts in the production drive of the Labor and Management Consultation Division of WPB in Pennsylvania, New Jersey, Delaware, Maryland and Virginia. He will serve as liaison officer on all manpower problems in which the WPB is concerned.

Brown had for the past 18 months been regional consultant to the Defense Plant Corp., subsidiary of RFC.

Biomechanics Symposium Jointly Sponsored

A symposium on biomechanics with special reference to high altitude flying, jointly sponsored by the Section on Engineering of the American Association for the Advancement of Science and the Biomechanics Committee of the American Society of Mechanical Engineers, is being held November 3, in the Engineering Societies Auditorium, New York City.

The papers to be presented include:

The Application of Engineering Principles to Clinical and Aviation Medicine — Alvan L. Barach, M. D. Associate professor of Clinical Medicine, College of Physicians and Surgeons.

Simulation of High Altitude Flying in the Laboratory— E. Lodwig, Mobile Refrigeration, Inc.

Some of the Problems of High Altitude Flying—Dr. Irving Fink, Army Air Corps.

Hockaday-Newby Now Hockaday Aircraft

Hockaday-Newby Aircraft, Inc. has sold its rights, title and interest to the Hockaday Aircraft Corp. Noel R. Hockaday, former president of Hockaday-Newby, is president and general manager of Hockaday Aircraft. The entire personnel, with the exception of H. L. Newby, has become a part of the new Hockaday corporation.

Fleet Aircraft Turns Out 1000th "Cornell"

Fleet Aircraft Ltd. celebrated the completion of its 1000th "Cornell" trainer with ceremonies at the Fort Erie, Ont., plant October 21. The plant reached this goal within a year, and this number also represents the 1942nd aircraft built since the plant opened in 1930 and the 1638th plane it has delivered since the war began.

To mark completion of this particular plane each employee is working the extra time required to build one "Cornell" and is donating it to the RCAF. The amount involved represents a gift of $12,000 on the part of the personnel.

The gift was received by Air Marshal L. S. Breadner, D.S.C., chief of the Air Staff, RCAF.

West Coast Aviation Writers Organize

West Coast Aviation Writers have been organized by representatives of newspapers and magazines in the Pacific states.

Objectives of the group as set forth in the constitution, are "to establish and maintain high standards of aviation coverage, to provide thorough and accredited group responsibility and accuracy in the gathering, preparation and dissemination of aeronautical information, and to insure reliability in all contacts with the aviation industry."

Officers are Marvin Miles, Los Angeles Times, president; Lawrence Black, Western Flying, vice-president; Peggy Guetter, American Aviation, secretary-treasurer. Other charter members include: Scholer Bangs, Aviation News; Reginald Burroughs, Western Flying; W. W. Ferguson, Los Angeles Daily News; James C. Galloway, AERO DIGEST; William Gray, Time; Gene Hand-

(*Continued on page* 401)

ONE of our fighting men writes: "I have used all kinds of Headsets—and Murdock is the best. Murdock can *take it!*"

That's why so many combat pilots order MURDOCK Radio Phones from us, at their own expense.

This ability to *stand up* under toughest conditions is one reason why America's industrial leaders have used MURDOCK for 39 years. MURDOCK Radio Phones guarantee you *supersensitive* reception. Messages come through "clear as a bell"—free from disturbing noises.

These precision-engineered headphones are the *world's keenest radio ears.* Now this battle-tested Headset is ready to serve American Business better than ever before.

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MURDOCK RADIO PHONES

Write Dept. 20 for Catalogue!

Wm. J. MURDOCK CO.
Chelsea, Massachusetts

Down with Down Time ... Up with Production!

A few years ago, ordinary cold drawn copper ... because of its high electrical and thermal conductivity ... was often used for resistance welding electrodes. But pure copper softens and "mushrooms" at the relatively low temperature of 390°F., resulting in poor welds and much down time for dressing.

Today, thanks to Mallory research, there are many improved electrode materials available. These special non-ferrous alloys and Elkonite* inserts produce more welds between dressings and need replacement less often. They speed resistance welding of similar and dissimilar metals ... from A to Z ... from aluminum to zinc!

Mallory 3 Metal*, for instance, is widely used for spot welding tips, seam welding rolls and flash welding dies. More than a dozen ferrous and non-ferrous metals and alloys can be joined faster, more soundly, and at lower cost, by using electrodes made of Mallory 3 Metal. These include cold-rolled steel, pickled hot-rolled steel, stainless steel, phosphor bronzes, silicon bronzes, nickel alloys, nickel silver and zinc.

Elkonite* (used as an electrode facing or insert) is recommended for projection and cross-wire welding, electroforging, electrical upsetting and electric brazing of all metals; for spot welding of pure copper, copper alloys and certain dissimilar metals; for flash and butt welding where the current density is extremely high.

Elkaloy A* is the accepted electrode material for spot, seam and flash welding aluminum and its alloys, and most types of plated metals.

Best results in welding materials of high electrical resistance such as Nichrome, Monel Metal and stainless steel are obtained, in many cases, by tips or wheels of Mallory 100 Metal.

INFORMATION FREE! Mallory engineers can help you choose the right electrode material, the correct design and cooling, for each specific resistance welding job. Write us for detailed information. Ask for your free copy of the MALLORY RESISTANCE WELDING DATA BOOK, if you don't have one. This book is a practical manual, widely used by welding engineers in the aircraft, shipbuilding, electrical manufacturing and dozens of other essential industries! Write us today.

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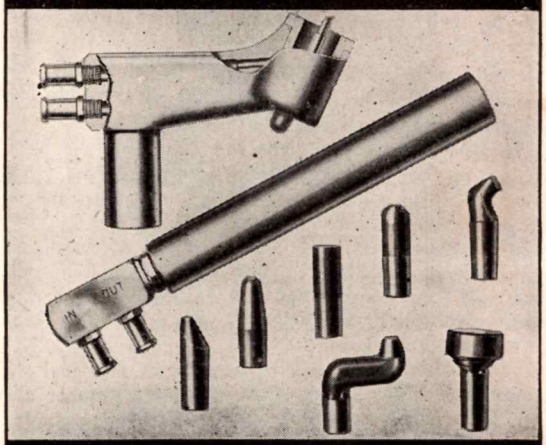
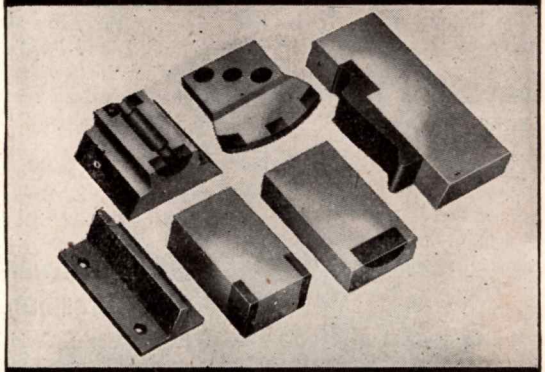
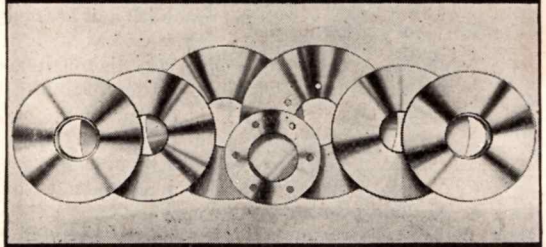


SPOT WELDING TIPS AND HOLDERS

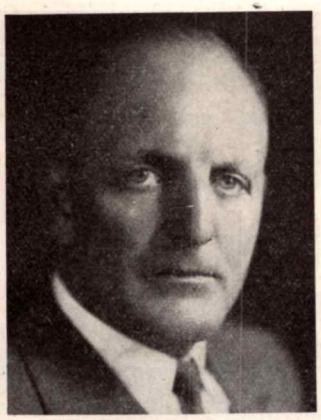


FLASH, BUTT, PROJECTION WELDING DIES



SEAM WELDING ROLLS

Speedier Production
Less Down Time
Better Welding
Lower [illegible]



Major Reuben E. Fleet, who has been elected to the presidency of the Institute of the Aeronautical Sciences for 1944

(*Continued from page* 399)
saker, Associated Press; Raymond Kay, Automotive and Aviation Industries; Gaither Littrell, Los Angeles Examiner; William R. Nelson, Aviation; Maxwell Thayer, Wall Street Journal, and John Watts, Hollywood Citizen News.

Spaatz Heads Newly Formed 15th Air Force

Lt. Gen. Carl A. Spaatz has been named by Gen. Dwight D. Eisenhower to head a newly organized 15th Air Force.

This unit will operate in conjunction with the 12th Air Force, likewise under the command of General Spaatz, "to greatly increase air power in the Mediterranean theater" and "to concentrate on long-range strategic bombing against Germany and military targets in occupied and satellite countries."

Announcement of the establishment of the new air force came on the heels of its first raid, a 1400-mile round-trip by *Fortresses* and *Liberators* to the *Messerschmitt* assembly plant near Vienna, Austria.

The 12th Air Force, a veteran of this area since the invasion of North Africa in November 1942, has been the largest United States air force in the field, employing the greatest variety of aircraft. Since February, it has been operating as the American division of the Northwest African Air Forces.

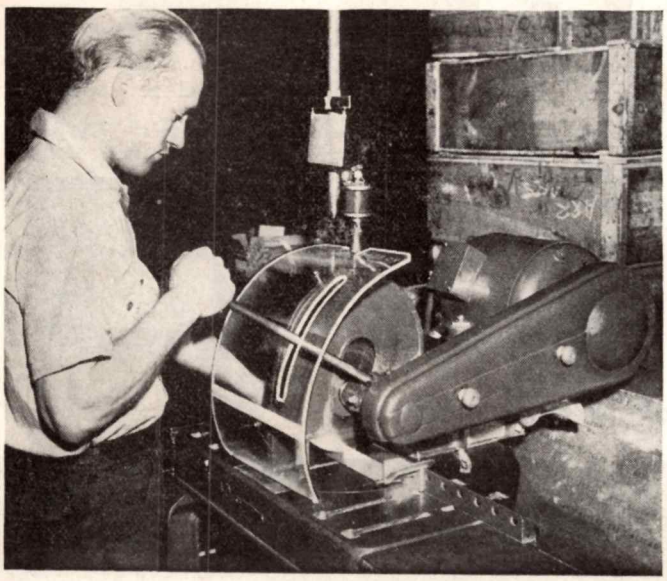
Both the 12th and the 15th will continue to team up with RAF and French units under the over-all command of Air Marshal Sir Arthur W. Tedder, Allied air chief.

Fleet Heads Institute for 1944

Major Reuben H. Fleet of San Diego, Calif. has been elected president of the Institute of the Aeronautical Sciences for the year 1944. Major Fleet will succeed Dr. Hugh L. Dryden of the National Bureau of Standards, who made the announcement.

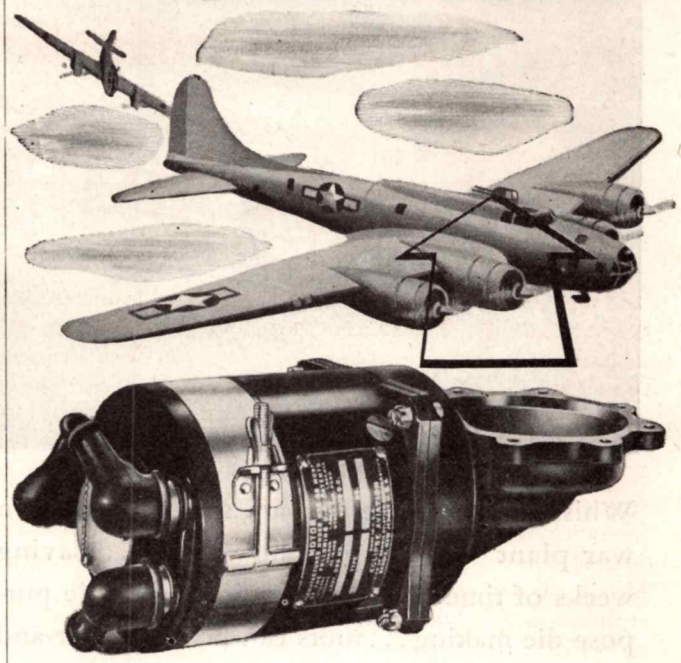
After resigning from the Army Air Corps in 1923, Major Fleet organized Consolidated Aircraft Corp., of which he was president until the end of 1941. At that time he sold his remaining interest to Vultee Aircraft, now Consolidated - Vultee Aircraft Corp. He continues as a consultant to the new management.

The membership of the Institute includes 5500 aeronautical engineers and scientists. Its annual meeting will be held on January 25th in New York.



Plexiglas saw-shields designed by Republic's Methods Engineering Department help prevent eye and head injuries. Plastics are playing an ever-increasing part in speeding production

SWING ON HIM!



AN enemy fighter dives out of the sun. "Pirate above—7 o'clock!" somebody sings out . . . and *instantly* the Fortress's top turret swings around to frame him in the gunner's sights.

The split-second timing of air fighting calls for *absolute* dependability in the electric control motors that operate revolving gun turrets on America's biggest bombers.

That's why these Eureka-made* controls . . . little larger than the motor in a vacuum cleaner . . . are precision-built to the highest standards of Eureka craftsmanship and skill.

*Designed by Eclipse Aviation Division, Bendix Aviation Corporation, and built by Eureka Vacuum Cleaner Company, Detroit

They give their lives, we lend our money. Buy more War Bonds.

Starter motors for fighting planes . . . motors that open and close bomb bay doors, and raise and lower landing gear . . . signal devices . . . aircraft fittings . . . are other precision-built Eureka wartime products.

BUILDERS OF ELECTRIC MOTORS FOR OVER 30 YEARS

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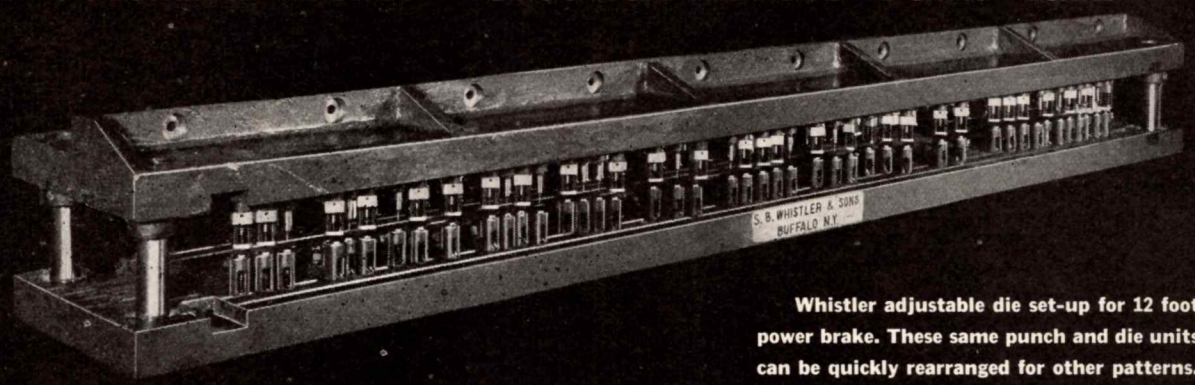
PRECISION...IN WAR AS IN PEACE

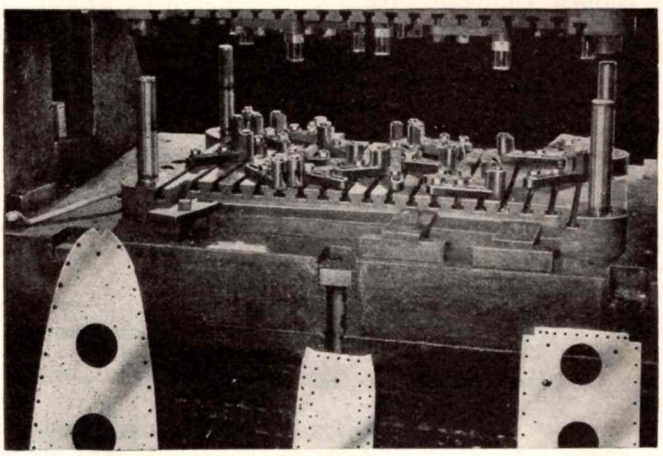
ADJUSTABLE DIES
SPEED WAR PRODUCTION

INCREASE HOURLY PRODUCTION—REDUCE "DOWN" TIME

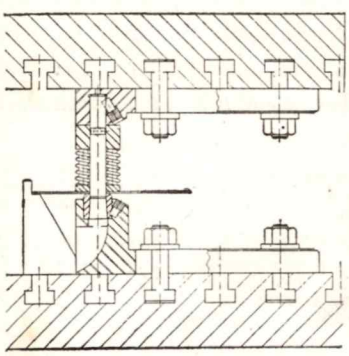


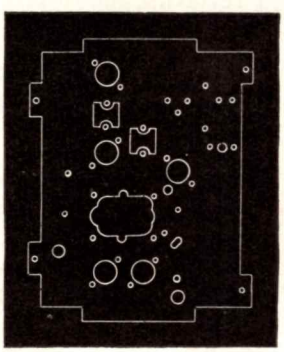
Whistler adjustable die set-up for 12 foot power brake. These same punch and die units can be quickly rearranged for other patterns.

Whistler Adjustable dies are saving the day in war plant "speed-up" schedules by... saving weeks of time normally required in single purpose die making... units can be used over and over in different patterns... new set ups on or off the press in minutes... all parts interchangeable ...work on any type press... perfect precision on long or short runs... no special tools and new workers quickly learn to make press changes.

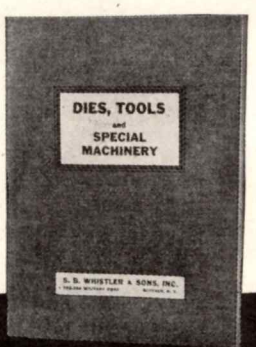


Another grouping of Whistler Adjustable Dies illustrating re-use of same units. Note close grouping of perforations.





Side view showing construction detail of U-50 Whistler Adjustable Punch and Die unit and typical example of perforated and notched piece produced by Whistler Dies.



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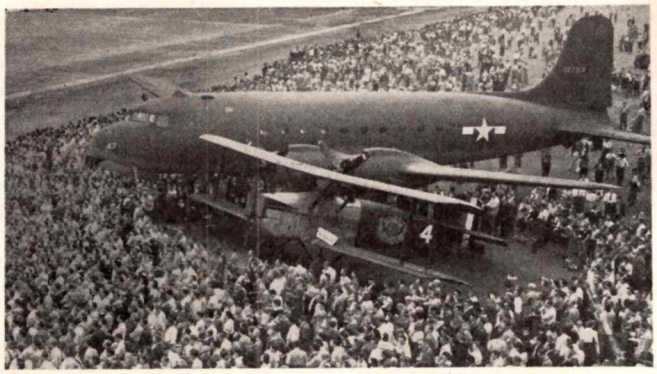

At a recent celebration held at the Douglas Santa Monica plant in commemoration of the first round-the-world flight, made in 172 days by the Douglas-built biplane "New Orleans", the historic plane poses under the wing of a "Skymaster" which dwarfs it

AIR TRANSPORTATION

Eagle Airlines New Railroad Subsidiary

Eagle Airlines, Inc., newly-formed subsidiary of the Missouri Pacific and Texas & Pacific Railways, has applied for permission to operate over a 6900-mile system interconnecting the routes which parallel the two railroads. The routes would serve nine midwestern, southern and southwestern states.

The airline proposed to connect 108 cities, with local service on 16 separate routes and through service as warranted between cities served by one or more of the routes. Temporary plans of the subsidiary also include through service to the eastern seaboard, Pacific coast, Mexico and northern points by connection with other airline services at its terminal gateways—such as St. Louis, Memphis, New Orleans, Brownsville, El Paso, Pueblo and Omaha.

Using helicopters and airplanes, the airline proposes five basic types of service; through coordinated air-highway service, through coordinated air-highway-rail service, through coordinated air-rail service, through and feeder service to and from connections with other carriers, and local and through air service.

TCA Transport Sets Another Record

For the second time a Trans-Canada Air Lines transport plane has established a new Montreal-to-Britain record. This record, a flight of 11 hr 56 min, was 30 minutes faster than the previous time made by a TCA crew in the first flight of the new overseas air mail service initiated on July 22 this year.

The transport carried the Hon. C. D. Howe, minister of munitions and supply; H. S. Symington, K. C., president of TCA; and J. F. Baldwin of the Privy Council office.

Western Buys Inland Air Lines

Western Air Lines has purchased Inland Air Lines, augmenting the former's border-to-border routes by approximately 1300 miles. On CAB's approval of the purchase, Western will absorb Inland, retaining the employees under the former's name.

The purchase will add to Western's route the cities of Lewistown and Billings, Mont.; Sheridan, Casper and Cheyenne, Wyo.; Denver, Colo.; Scottsbluff, Nebr.: and Rapid City, Pierre and Huron, S. D.

President William A. Coulter of Western states that negotiations have been completed with the four largest stockholders, headed by Richard Leffrink, controling in excess of 83% of Inland's stock.

Army Returns Fourteen Planes to Airlines

With 14 transport planes returned to the airlines by the Army, air mail and cargo bottlenecks are being relieved. The released aircraft represent nearly a ten percent addition to the number of planes in the service of commercial carriers—which had been stripped of half of their 400-odd units at the start of the war. The release of planes began July 1.

Parks Air College Seeks Routes

Parks Air College, East St. Louis, is planning to apply for certificates of public convenience and necessity for operation of carrier service over 35 routes

FEET COVERED WITH NEW GUINEA MUD WON'T SLIP ON

WETORDRY Safety Walk
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MINERAL COATED FABRIC
for all non-slip purposes

Pilots and mechanics are finding that wing walks of WETORDRY Safety Walk give them a safe, sure footing under all circumstances. This husky mineral-coated non-slip material has a firm "bite" . . . even on wet, muddy shoe soles . . . that makes wing walks almost as easy to travel as a city sidewalk. When applied with WETORDRY Safety Walk ADHESIVE it goes on easily; adheres securely to metal, plywood or fabric; gives a waterproof, weather-proof, slip-proof covering that stands up under the hardest use. If you haven't tried WETORDRY Safety Walk, a 3-M Sales Engineer will be glad to give you all of the facts about it. Just fill in and mail the coupon below.

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Please have a Sales Engineer see us regarding WETORDRY Safety Walk.
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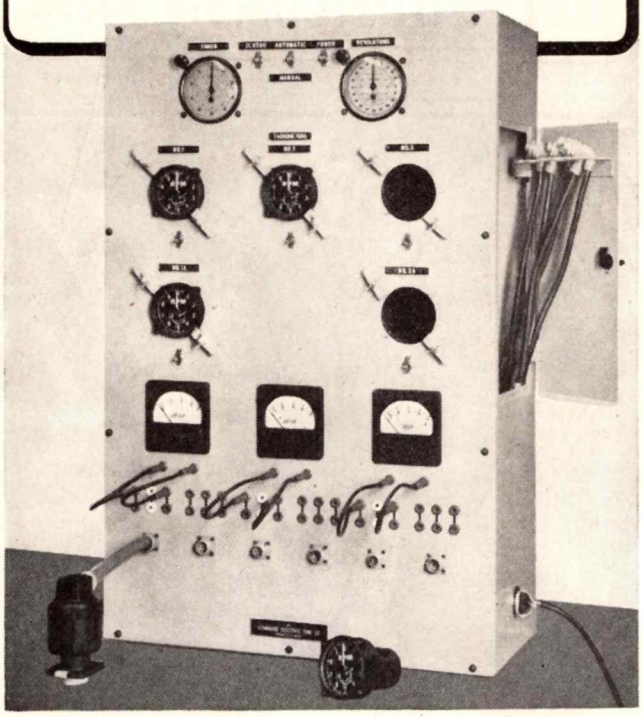
★ BUY MORE WAR BONDS ★

Aircraft Engine Makers!

A NEW STANDARD ELECTRIC TEST UNIT--



FOR AIRCRAFT TACHOMETER INDICATORS AND GENERATORS

This efficient unit fills the need for a combination of instruments for testing and calibrating aircraft-type Tachometer Indicators and Generators. It is used in connection with a variable speed drive for driving Generators and the Revolution Counter.

The timer and revolution counter are the primary standards for integration of time and revolutions form a precision Chronotachometer accurate to 1/1000 of a minute and to ½ of a revolution. This Chronotachometer is used as a Master R.P.M. indicator, with which the aircraft instrument indication is compared.

Features and equipment include: Provision for plugging in five Tachometer Indicators, complete with flexible cords and AN plugs; AN receptacles for plugging generator outputs; three special low-burden voltmeters to indicate voltage output, open coils, short circuits, etc.; receptacles and plugs to connect all types of Tachometers. . . . Address inquiries to **AD 11.**

THE STANDARD ELECTRIC TIME CO.

"Split-Second Measurement by Standard"

SPRINGFIELD, MASSACHUSETTS

averaging 500 miles each, to serve an area bounded by Minneapolis and Detroit on the north, and Dallas, Tex., and Albuquerque, N. M., on the south. Route miles would total 13,343 and would serve 473 communities of 4000 or more population.

The college proposes to establish bases at Chicago, Indianapolis, St. Louis, Kansas City and Tulsa. Tentative plans call for two round trips daily. The organization expects to use twin-engined airplanes.

Otto Aviation Wants New Jersey Routes

The airline division of the Otto Aviation Corp. of Newark, N. J., has applied to CAB for authority to carry passengers, mail and cargo over five separate air routes entirely within the state of New Jersey. This is the first applicant for a purely intra-state route.

The corporation, as one of 18 regular runs, would offer 20-minute service between Newark and Trenton. Twin-engined transport planes equipped to carry eight passengers, with additional space for mail and cargo, would be used. Seaplanes operating from the Newark seaplane base as well as landplanes are expected to be part of the equipment.

Airlines Report Traffic Increasing

The airlines are still reporting increases in traffic, with figures at an all-time high. Included among the companies revealing record months is Northwest Airlines, which reports September air mail cargo amounting to 522,848 air mail pounds, an increase of more than 42,000 pounds over August. The planes flew a total of 413,431,264 pound miles, while express pounds reached a total of 152,936—an increase of 11,588 over August and 50,000 more than July.

For the month of September, Northwest reports an estimated 10,125 revenue passengers, nearly twice as many as in the same month in 1942. Other figures show that the airline flew 7,000,000 revenue passenger miles during the month — about 100,000 more than in the record month of August—and 3,000,000 more than September last year.

PCA Air Express

Air express carried by Pennsylvania Central Airlines increased 66% and air mail 62% for the first nine months of this year, as compared with the same period in 1942. Express ton miles totalled 284,934, as compared with 171,687 last year. In September, 37,000 express ton miles were flown, as compared with 23,129 ton miles last year. Air mail ton miles in the same month were 39,666, as against 32,975 last year.

An interior view of one of the new "cargoliners" of United Air Lines' coast-to-coast all-freight service. Douglas DC-3 passenger planes have been refurnished and provided with plywood floors and siding, steel screen windows and cargo bins averaging three tons capacity

Revenue plane miles increased 26% with 289,827 being flown, as compared with PCA's 230,113 in September 1942. Revenue passenger miles increased from 3,907,495 to 5,145,058, while the passenger load factor was boosted from 81.50% to 84.50%. Revenue passengers carried totalled 24,401 in September this year against a total of 18,107 last year—a gain of 35%. The passenger load factor for this year's first three quotas showed an increase of 17.27%.

United Gains

United Air Lines' business report for September shows a gain of 25% over the same month in 1942. United flew 35,048,300 revenue passenger miles last month as against 27,952,746 during the same month in 1942, and 33,867,212 during August this year. Airplane miles totalled 1,999,180 as compared with

(*Continued on page* 407)

This message has been prepared as a tribute to America's fighting men and in the hope that it may hold a measure of inspiration for those who must carry on the battle here at home.

CAN YOU LOOK HIM IN THE EYE?

They found him slumped by his gun on the cartridge-strewn ground he had so fiercely defended, as still as the enemy dead huddled there around him. Though three times wounded, he had kept on firing until unconsciousness dragged his finger from the trigger.

He wouldn't quit then. And he won't quit now! In a few more weeks, when his wounds have healed, he'll go back to help finish that job in the jungle. Can you look him in the eye and truthfully tell him that you, too, are doing all that you can to finish the job?

In the days ahead, can he count on you to stick to your war post as faithfully as he sticks to his? Can he expect you to buy War Bonds in the willing spirit he shows when he steps to the front as a volunteer? Can he rely on you to give a little blood to the Red Cross as ungrudgingly as he gives up his on the battlefield? Can he really depend on you to fight inflation over here while he is fighting oppression over there?

When your conscience tells you that you're worthy of the sacrifices he's making for *you*—only then can you proudly look him in the eye!

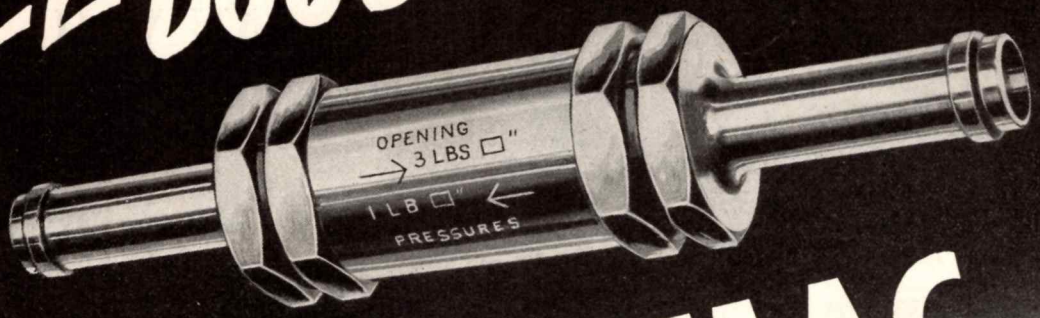
Belmont Radio

TELEVISION • F-M • ELECTRONICS

Belmont Radio Corporation, 5921 Dickens, Chicago 39, Illinois

KEEP BUYING MORE WAR BONDS!

CHECK and DOUBLE CHECK



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DUAL CHECK VALVE for FLUIDS

★ ***Controls flow in either direction at predetermined pressures.***

Developed by Aeromac engineers to meet a specific aircraft requirement, the Aeromac Dual Check Valve provides positive control of low pressures and flow directions. The unique arrangement of valves, each of which may be set to any predetermined pressure from 1 lb. per sq. in. or less up to 10 lbs. per sq. in. or more for the flow direction which it regulates, affords a dependable double check on fluid movement, and prevents excessive flow which might result from the plane's maneuvers.

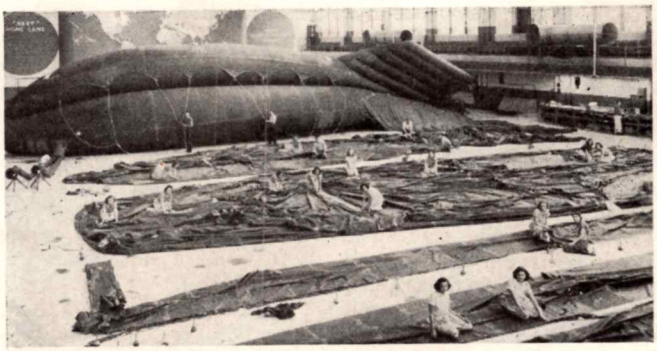
The Aeromac Dual Check Valve weighs only 2½ ozs. (for ½" tubing). It is ruggedly built, accurately machined and cárefully assembled. Pressures are factory set as specified. This valve is supplied with any desired combination of end connections, for example, hose to hose, hose to male or female pipe fitting, hose to tube fitting as required.

Engineering data will be sent on request.

AERONAUTICAL MANUFACTURING CORPORATION

AEROMAC ★ Valves ★

375 FOURTH STREET
Niagara Falls, N. Y.



Construction of barrage balloons at Goodyear Tire and Rubber Co. The balloon in the background has a capacity of 68,000 cu ft of helium and achieves an altitude of 15,000 ft

(*Continued from page* 404)
1,711,166 in September 1942—an increase of 10%.

United also reports a jump of 33% in air mail ton miles flown during September. The airline flew 852,647 mail ton miles, as compared to 641,331 in the corresponding month last year. Express ton miles totalled 8% below the total for September 1942 and 4% below August 1943.

TWA Now Controls Inter-American Airways

Transcontinental and Western Air recently completed transactions which place it in control of Inter-American Airways. The latter comprises four airlines representing the largest independent Latin-American carrier system. In partnership with TWA in the acquisition of some 51% control, are stock purchasers including Time, Inc.; Stewart McDonald, chairman of Maryland Casualty; and Adams Express.

The airline, formerly known as Transportes Aereos Centro-Americanos—a name it has resumed under the new ownership—was founded in 1930 by Lowell Yerex, a New Zealander who built it up from a zone-plane business to its present capacity. Inter-American carries more air freight than any other line in the world.

Yerex Named Head

Yerex, who has been named president of the company, owns 17% of the stock, while about 1000 persons of British citizenship own about 23%. President Jack Frye of TWA, which acquired about 38% of the stock, states that neither stock purchases made by his company nor other buyers will constitute a majority interest, although their holdings do represent control. In addition to these stockholders, it is indicated that another purchaser from the United States will enter the picture.

Since no single purchaser gained majority control the transaction was not subject to CAB approval. However, CAB approval will be necessary before a representative of TWA can sit on the TACA board.

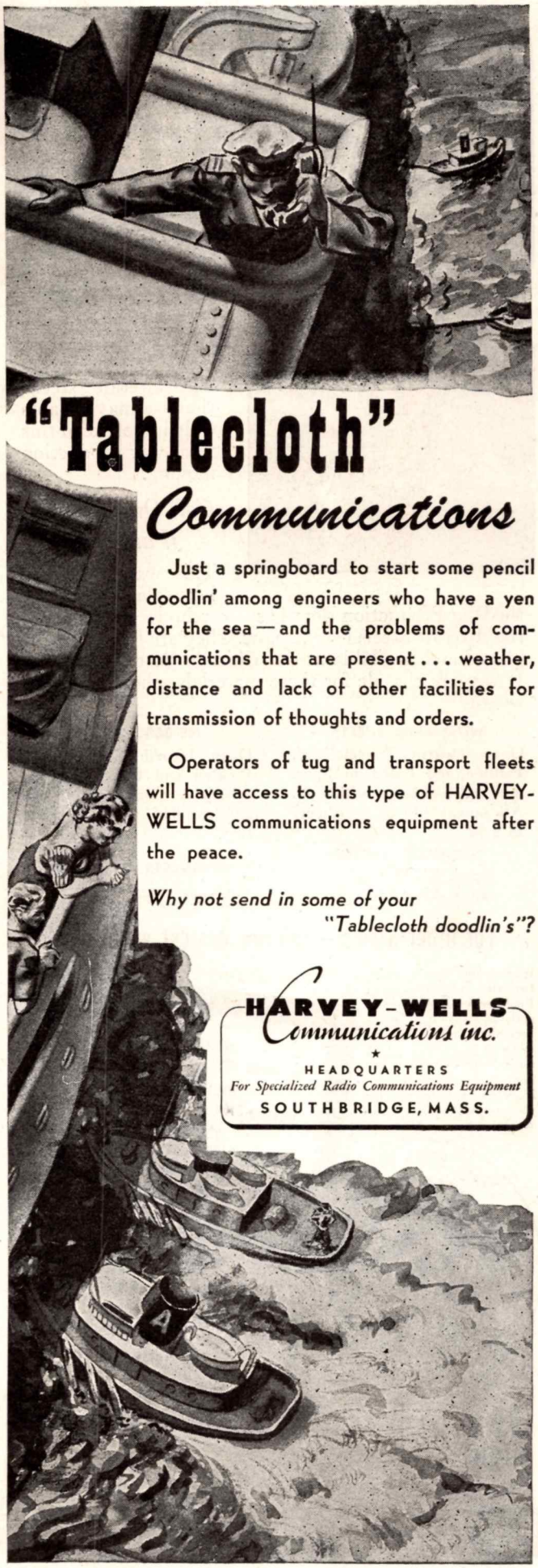
Included in the TACA system are Transportes Aereos Centro-Americanos S. A., which services Honduras and British Honduras; Compañia de Transportes Aereos Centro-Americanos de Costa Rica, which operates in Costa Rica and Panama; Compañia Nacional TACA de Nicaragua, which flys routes in Nicaragua; and TACA, Sociedad Anónima, which operates between points in Costa Rica, Nicaragua, Honduras and El Salvador.

BWIA Included

Also included in the system are British West Indian Airways—organized by Yerex in 1941—which flies from Port-of-Spain to Tobago, Barbados and Granada and holds temporary certificates for Miami entry; and Aerovías Brasil, organized in 1942, operating through Brasil with a contract operation to Miami. The latter line is a competitor of Pan American Airways.

CAL, Delta and TWA Apply for New Routes

Continental Air Lines, Delta Air Lines and Transcontinental and Western Air are the most recent applicants for new routes. Continental has made two applications, the first asking for extension and consolidation of two of its present routes with Memphis, Tenn., as the terminal. The two routes, from Tulsa, Okla., and from Kansas City to Memphis, would join the airline's present routes to Tulsa and to Kansas City, from Denver. The former of the proposed routes would go via Muskogee, Okla., Fort Smith and Little Rock, Ark.; while the latter route would cover the territory via Joplin and Springfield, Mo., and Jonesboro, Ark.



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THEN remember, if you need special aircraft steels, that we may be able to help you keep this vital war production moving.

Call Our Chicago Warehouse

This warehouse has been designated by the War Production Board as a warehouse to distribute the Aircraft Steels listed below. They are for use in airplanes and available at our Chicago Warehouse only. If you are eligible for these materials, phone, write or wire us.

WD-X-4130 SHEETS

Open Hearth, Normalized, Pickled and Oiled to Spec. AN-QQ-S-685, Condition N. All gauges .016 to .50, sheets 18 x 72".

NE-8630 SHEETS

Open Hearth, Normalized, Pickled and Oiled to Spec. AN-S-12, Condition N. All gauges .016 to .50, sheets 18 x 72".

STAINLESS SHEETS

Spec. AN-QQ-S-772.
Spec. AN-QQ-S-757.

STAINLESS STEEL BARS

Spec. AN-QQ-S-771.

For other Steels — call our nearest warehouse

We welcome your inquiries for the new National Emergency Alloy Steels, and for steel, steel products, tools and machinery. We will do our best to fill your orders—subject, of course, to priority restrictions. Phone, write or wire the nearest of our nine warehouses.

CHICAGO (90) BRUnswick 2000 Teletype CG. 605
BALTIMORE (3) GILmore 3100 Teletype BA. 183
BOSTON (34) STAdium 9400 Teletype BRTN. 10
CLEVELAND (14) HEnderson 5750 Teletype CV. 153
MILWAUKEE (1) Mitchell 7500 Teletype MI. 587
NEWARK (1), N. J. Bigelow 3-5920 REctor 2-6560 BErgen 3-1614 - Teletype NK. 74
PITTSBURGH (12) CEdar 7780 Teletype PG. 475
ST. LOUIS (3) MAin 5235 Teletype SL. 384
TWIN CITY - St. Paul (4) NEstor 2821 Teletype STP. 154

UNITED STATES STEEL SUPPLY COMPANY — USS STEELS — SERVICE

UNITED STATES STEEL SUPPLY COMPANY

UNITED STATES STEEL

Continental officials state that the extension would add 958 air miles to the present system and serve a combined population of 1,264,000.

A later application filed by this company seeks to extend its present routes to include operations between Tulsa and Hobbs, N. M. This route would provide service to five additional cities: Shawnee, Oklahoma City and Lawton, Okla.; Wichita Falls and Lubbock, Tex.

Delta Air Lines has asked permission to provide direct service between Kansas City, Mo., and New Orleans, and between Birmingham, Ala., and Dallas and Fort Worth, Tex.—via Arkansas and Oklahoma. The airline also asked authority to amplify its present application for a route from Birmingham to Kansas City, with an extension that would run from the intermediate point, Memphis, to Dallas and Fort Worth via Little Rock, Fort Smith, Muskogee, Tulsa and Oklahoma City. The new application adds seven cities to the 23 Delta asked authority to service in August.

Transcontinental & Western Air is filing an application with CAB to establish routes to the Azores from Washington, New York, Boston, Chicago and Detroit. The new routes would be a continuance of TWA's war effort, acording to Jack Frye, president.

THE AIR SERVICES

Biggest Blimp, the M-1, Being Test Flown

The new M-1, the world's largest non-rigid airship, now is being test flown by Goodyear Aircraft Corp. To be used by the Navy in patrol work, it is 40 feet longer than the K ships now cruising over the Atlantic coast waters, and is larger than the Army's RS-1, the 1924 model. The M-1 has a gas capacity of 650,000 cu ft, a 50 percent greater volume than the K ships. Although the speed has not been released it will be greater than the K type, as will also be the cruising radius and the bomb-carrying ability.

A feature of the M-ship is the car which is divided into three connecting, Pullman-like units integrated by universal joints to allow freedom of motion in coordination with the flexible envelope above. Present airships have one car. Three times as long as that of the K ship to distribute the weight, the car measures approximately 290 ft in length. The outriggers carry two *Wasp* engines attached to the midship unit, which has a blister below for wider range of observation and use of machine guns.

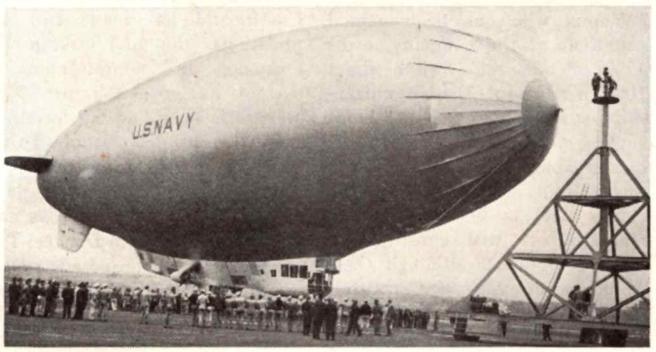
The M-1 design, developed by Navy and Goodyear engineers, represents the largest accumulation of airship design experience, dating back to World War I when Goodyear built nearly 1000 observation and training balloons and many airships.

With the M-1, the Navy now has four sizes of blimps: the L-ships of 123,000 cu ft, trainers; the G-ships of 196,000 cu ft, "flying classrooms," and the K ships of 425,000 cu ft, patrol ships.

Wanted: 70,000 Air WACS

In a campaign to enlist 70,000 women for the Women's Air Corps to be assigned to the Army Air Forces, for the first time applicants will be allowed to choose the command they wish to join. Women enlisting may designate either the Army Ground Forces, or Army Service Forces. Carrying the new freedom a step further, the War Department allows interested women to visit various posts and observe how the particular job they request

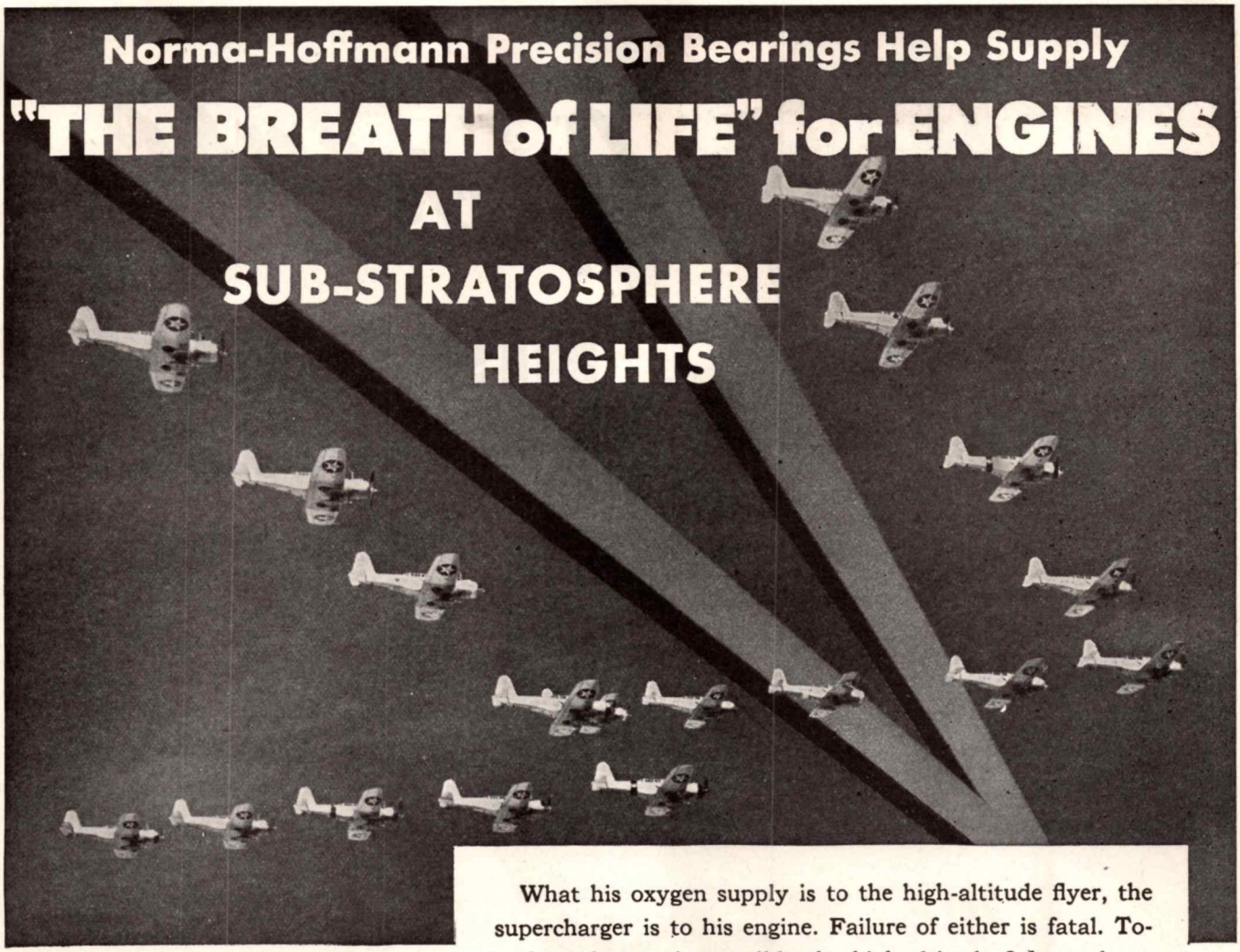
(*Continued on page* 411)



The Navy's newest and largest non-rigid aircraft, the M-1, built by Goodyear, on trial flight

Norma-Hoffmann Precision Bearings Help Supply

"THE BREATH of LIFE" for ENGINES AT SUB-STRATOSPHERE HEIGHTS



What his oxygen supply is to the high-altitude flyer, the supercharger is to his engine. Failure of either is fatal. Together, they make possible the high-altitude fighter planes and bombers that are playing so conspicuous a part in today's warfare.

In the use of anti-friction bearings in superchargers, as in so many other aviation applications, NORMA-HOFFMANN pioneered the way. The terrific speeds of supercharger operation—often as high as 60,000 RPM—demand that ULTRA-PRECISION long characteristic of NORMA-HOFFMANN BEARINGS. And today, not only in superchargers but elsewhere at vital points throughout the plane, NORMA-HOFFMANN PRECISION BEARINGS are doing their part in winning air supremacy for the Allied Air Forces in every theatre of war.

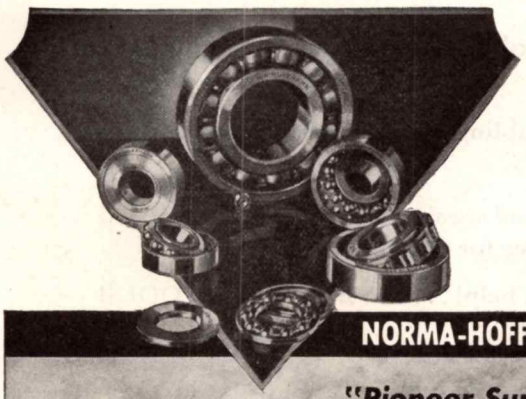
"Where the bearings MUST NOT fail"—in engines, control mechanisms, instruments, armament, radio equipment and other aircraft accessories—they are providing that combination of speedability, load capacity and dependability so vital to the unfailing performance of the plane.

Let our engineers work with you.

"NORMA-HOFFMANN"

PRECISION BEARINGS

BALL, ROLLER AND THRUST



NORMA-HOFFMANN BEARINGS CORP'N, STAMFORD, CONN. . . . FOUNDED 1911

"Pioneer Suppliers for 20 Years of Ultra-Precision Bearings for Superchargers"

TO WIN THE WAR—*Work—Fight—Buy War Bonds!*

Increase HIS ABILITY

Give Him AIR TOOLS

Every worker has the desire to produce. Give him the proper tools and he'll do it.

Any portable power tool will increase the output of the operator's hands, but a lighter, smaller AIR tool of comparable power will *further* increase his production.

Ingersoll-Rand AIR tools are wanted by men on production lines. Here's why . . . . . .

LIGHT WEIGHT . . . *Air tools are lighter in weight* than other types of portable power tools, and are about *one-half the size.* This is an important factor in reducing operator fatigue.

FLEXIBILITY . . . *Air tools give maximum power immediately.* Starting and stopping are practically instantaneous. This speeds up repetitive operations. *Regulation of power* permits the use of the tools on many kinds of materials and on many types of operations.

DURABILITY . . . *Trouble-free service* is assured by the sturdy construction of AIR tools. AIR motors cannot be damaged by overloading.

POWER . . . *Air tools have more power per pound,* thereby enabling the operator to produce more work with less effort.

SAFETY . . . *Air tools are safe* because they are easy to handle and are simple in design. Compressed air is the safest medium for the transmission of power for portable tools.

Give the man on your production line every possible help! . . . GIVE HIM AIR TOOLS!

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

8-350

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • CONDENSERS • DIESEL ENGINES • CENTRIFUGAL PUMPS

(*Continued from page 408*)
is handled in the Air Forces.

While the Army needs more than half the number for clerical and office duties, the applicants can, without previous training, receive the Army orientation course and take over such jobs as air mechanics, weather observers, control-tower operators, or Link trainer operators.

War Department Seeks Maps of Foreign Lands

The War Department, Army Map Service, is seeking maps, city plans, port plans, place name lexicons, gazeteers, guide books, geographical journals and geological bulletins covering all foreign areas outside the continental limits of the United States and Canada. Of particular interest are maps and guide books purchased within the last ten years, including maps issued by the U. S. Government and the National Geographical Society.

The public is asked to donate this material or lend it to the War Department for the duration, or long enough for reproductions to be made. Franked labels will be forwarded to donors.

It is important to indicate what is not wanted. Maps should be mailed to Miss Viohla Klipell, head of N. Y. Library Branch, Army Map Service, 1270—6th Ave., New York 20, N. Y.

Howard "Nightingale" Flying Ambulance

The Navy and Marine Corps in the combat zones are now utilizing a high-speed ambulance airplane that carries out its mercy missions at the rate of two-and-one-half miles a minute. A standard model of the Howard Aircraft Corp., the plane has a 450 hp engine, and features a special stretcher door which opens on the right, back of the cockpit door. The aircraft will carry two patients, and a pilot, co-pilot and nurse. Its range enables it to operate from bases as far as 200 miles from battle areas, and it can land in almost inaccessible spots, according to the manufacturers.

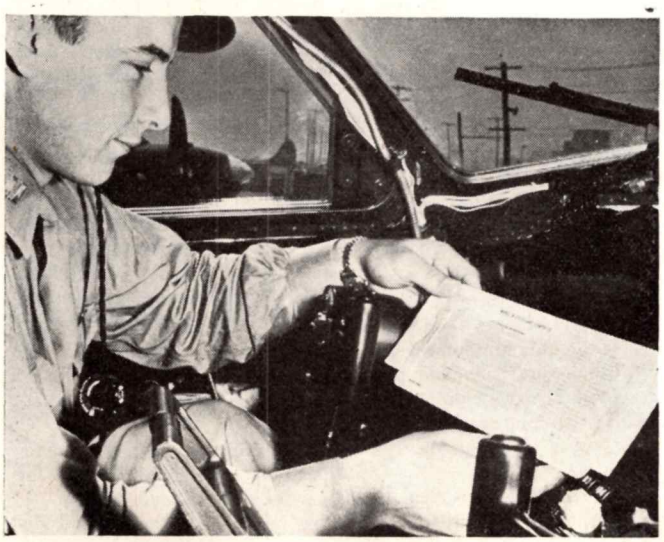
The plane has been named the Howard *Nightingale*, in honor of Florence Nightingale.

Except for its special adaptation to ambulance purposes, the plane is the same as that which Howard produced before the war. Other Howard planes of the same design are in use by the Navy in two other fields, one for administration both in this country and in foreign zones and the other as an advanced blind flying trainer.

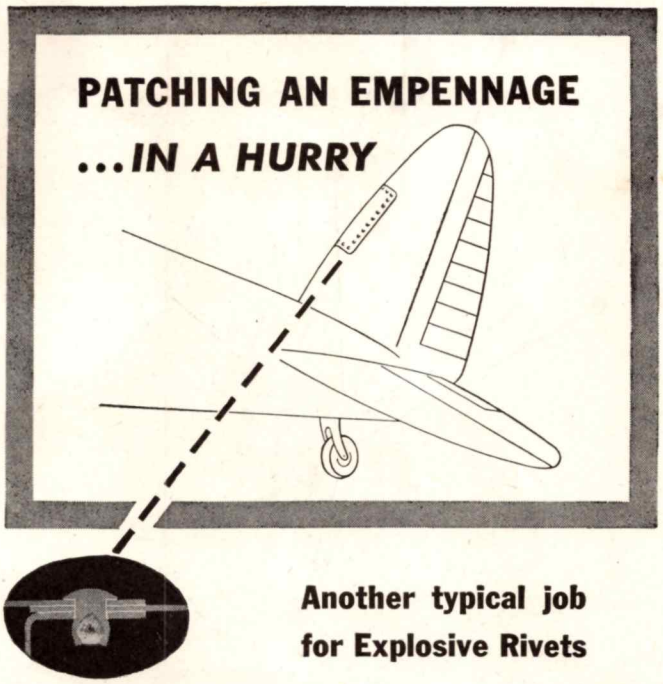
Navy Establishes Aeronautics Section

An Aeronautics Section in the Industrial Incentive Division of the Navy has been established for the purpose of stimulating production in the plants of aircarft manufacturers and their subcontractors.

Rear Admiral C. H. Woodward, chief of the Industrial Division, states that an attempt is being made "to bring the war closer to the workers' benches" by means of pictures and releases to employee publications, by rallies attended by returned combat veterans and by broadcasts of war news in the war factories.



Capt. Frank Schwab, AAF pilot, operates the new "Flide Rule," a combination flight computer and slide rule, developed by Boeing engineers for "Fortress" pilots. The instrument accomplishes many complicated calculations automatically, enabling pilots to make split-second decisions in emergencies



Another typical job for Explosive Rivets

Tears, holes and similar damage to empennage, wings, doors and other metal parts of a plane can often be repaired by blind riveting a patch over the damaged area. This avoids dismantling—saves time.

Du Pont Explosive Rivets simplify the blind riveting required and help get the job done *fast.*

The patch is clamped in position. Holes are drilled and Explosive Rivets inserted in them. The tip of an electrically heated Du Pont Riveting Iron is applied to rivet heads. This fires a tiny expansion charge in the solid shank of the rivet, forming a blind head that securely sets the rivet in place.

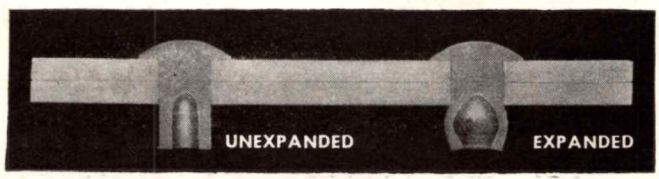
It's a quick and easy one-man, one-operation job. Riveters can readily set from 10 to 20 Explosive Rivets per minute. And the one-piece solid shank gives the nearest thing to a solid rivet.

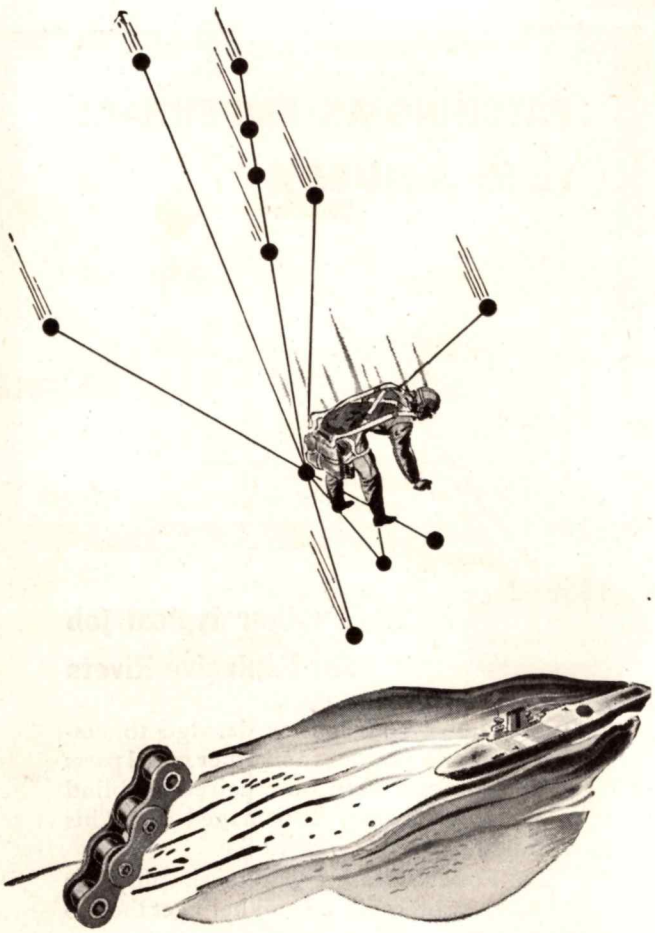
Investigate these time-saving Du Pont Explosive Rivets. Millions are being used on production lines and for repair and maintenance. E. I. du Pont de Nemours & Co. (Inc.), Explosives Dept., 5494-R Nemours Bldg., Wilmington, Del.; 5-236-R General Motors Bldg., Detroit, Mich.; 5801-R So. Broadway, Los Angeles, Calif.

DU PONT
REG. U. S. PAT. OFF.

EXPLOSIVE RIVETS

The one-piece blind fastener with a solid shank





Command PERFORMANCE

Screaming down in a power dive—when the slightest mistake means disaster—the muscular and nervous systems of a plane must respond instantly to the commands of its brain—the pilot. To insure this instantaneous response so vital in today's warplanes, many manufacturers have standardized on muscles and sinews of Baldwin roller chain belt for as many as 12 important control points.

Baldwin Roller chain belts assure positive control at the following points:

Ailerons	Nose Wheel Doors
Wing Flaps	Sliding Hood
Rudders	Power Turrets
Elevators	Arresting Hook
Bomb Bay Doors	Retractable Landing Gear
Tail Wheel Doors	Control Column

For these and other tasks, the positive grip of chain belts on sprocket teeth has proved the best method ever devised. The ability to absorb the terrific shock of war plane operation, smoothness of operation and high strength to low weight ratio are other factors in the wide preference for Baldwin. Baldwin-Duckworth Division of Chain Belt Company, 340 Plainfield Street, Springfield, Mass. Factories at Springfield and Worcester, Mass.

BALDWIN
ROLLER CHAIN BELTS FOR AVIATION . . .

FINANCIAL BRIEFS

Following are the highlights of the financial news of the month, of interest to the industry.

All American Aviation, Inc. earned a net profit of $27,689.68 in the fiscal year ended June 30, as compared to a net loss of $22,407.40 in the previous year. At the same time the company reports an earned surplus balance of $11,409.97. Since June 30, the company has obtained $655,450 in additional capital through the sale of 26,218 shares of preferred and all of the company's notes payable have been liquidated with the exception of $150,000 outstanding under a V-loan agreement.

Aviation Corp.

Net sales of the Aviation Corp. for the nine months ended August 31 amount to $57,234,555, almost double the $29,635,211 volume for the corresponding period in 1942. Net income before Federal taxes totalled $9,727,486 as compared with $8,371,716 for the previous nine months. Net income after all charges and taxes for the period was $2,810,486, equal to 49 cents per share of capital stock, as compared with $3,671,716, or 64 cents per share, for the same period last year. The Federal tax provision totalled $6,917,000, equivalent to $1.19 per share, or almost two and one-half times net earnings. Taxes for the same period a year ago were $4,700,000, or 81 cents per share.

Borg-Warner

For the first half of 1943 Borg-Warner Corp., reports a net profit of $4,665,447, or $1.99 a share on 2,336,725 shares of $5.00 par value common stock outstanding, after provisions of $25,606,758 for Federal and Canadian income and excess profits taxes. For the same period last year net profit was $3,986,366, equal to $1.70 a share, after $13,956,414 had been deducted for taxes. Taxes for 1943 were based on rates slightly higher than those provided by the present revenue law without provision for post-war refund of excess profits taxes, while the comparative figures for 1942 were based on the 1941 rates plus 25%.

Braniff Airways, Inc., for the five months to May 31 of this year reported a net income of $358,948, equal to ninety cents each on 400,000 shares as compared with $99,326 or 25 cents a share for the corresponding period last year.

Continental Motors Corp. reported net profits for the nine monts ending July 31 of $4,375,626.91, after all charges including depreciation, Federal income taxes, excess profits taxes, and after allowing for reserves and charge-offs.

Electric Auto-Lite

For the six months ended June 30, the net income of the Electric Auto-Lite Co. totaled $2,517,212 after taxes and charges, equal to $2.10 a share on the common shares. This compares with $2,119,551 equivalent to $1.77 a share, for the same period a year ago.

General Electric Co.'s sales in the first nine months of this year amounted to $980,226,836 as compared with $654,822,607 in 1942. The profit available for dividends was $31,433,933, equal to $1.09 a share on 28,845,927 shares of capital stock. Total earnings of the more than 170,000 employees amounted to $345,000,000 as compared with the earnings of the 134,000 employees last year who were paid $271,000,000. Federal income and excess profits taxes totalled $201,000,000, against $114,000,000 in 1942. The company credited itself with $18,500,000 for post-war refund of excess profits taxes, but balanced this credit by setting up a reserve of $18,500,000 for peacetime readjustments and contingencies.

Lockheed and Vega

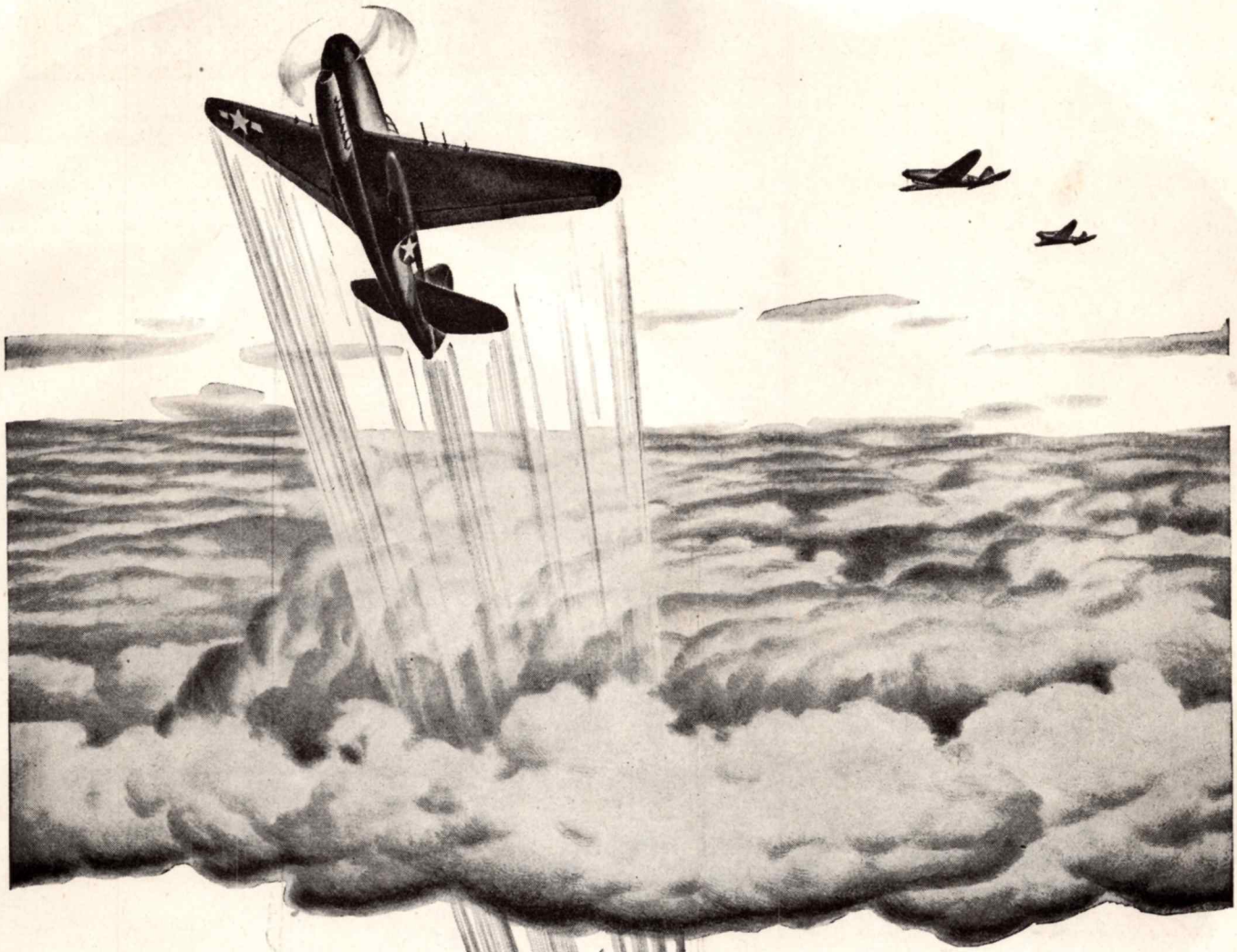
Lockheed and Vega factories brought their output up to $330,000,000 for the first six months of 1943, more than double that of the corresponding period of 1942.

In a report to the stockholders, president Robert E. Gross, included an announcement of renegotiation adjustment; comments on renegotiation methods that ignore post-war needs; a statement concerning the effect on industry of selective service and a description of Lockheed's purchase of Pacific Finance Corp.

Northrop

Northrop Aircraft, Inc., reports net sales of $69,791,844 for the fiscal year ended July 31. Net income for that period decreased to $1,249,535, equal to $3.12 a share, from $3,044,741, or $7.93 a share the previous year.

(*Continued on page* 415)



NOTHING TO IT, EH?

Modern war planes can climb a mile a minute. In very few minutes a fast climber can be up in the sub-stratosphere. But . . .

Temperature takes a nose dive as the plane soars higher. At 20,000 feet the temperature is well below zero. Apparently at about 35,000 it becomes fixed . . . *at 70 degrees below zero* in the temperate zone. Over the equator, stratosphere temperature drops as low as 100 degrees below zero.

Both pilot and plane encounter troubles in the bitter-cold, rarefied air of the sub-stratosphere. Moisture freezes, oil congeals, engines gasp and die unless aided by turbo-superchargers.

Nevertheless, planes and pilots are learning to fight at higher and higher levels—thanks to research conducted on the ground in test chambers which reproduce the conditions of the stratosphere. Accurately controlled *air conditioning and refrigeration*...plus controlled pressure...make these tests possible.

This is one of the many interesting and important ways in which air conditioning is contributing to our war effort. To do the tasks of war time, General Electric has developed dependable air conditioning and industrial refrigeration equipment...equipment that is more flexible, more compact, more efficient.

After the war, lessons learned in wartime production will be applied to making better peacetime air conditioning. This will be made available to all from General Electric.

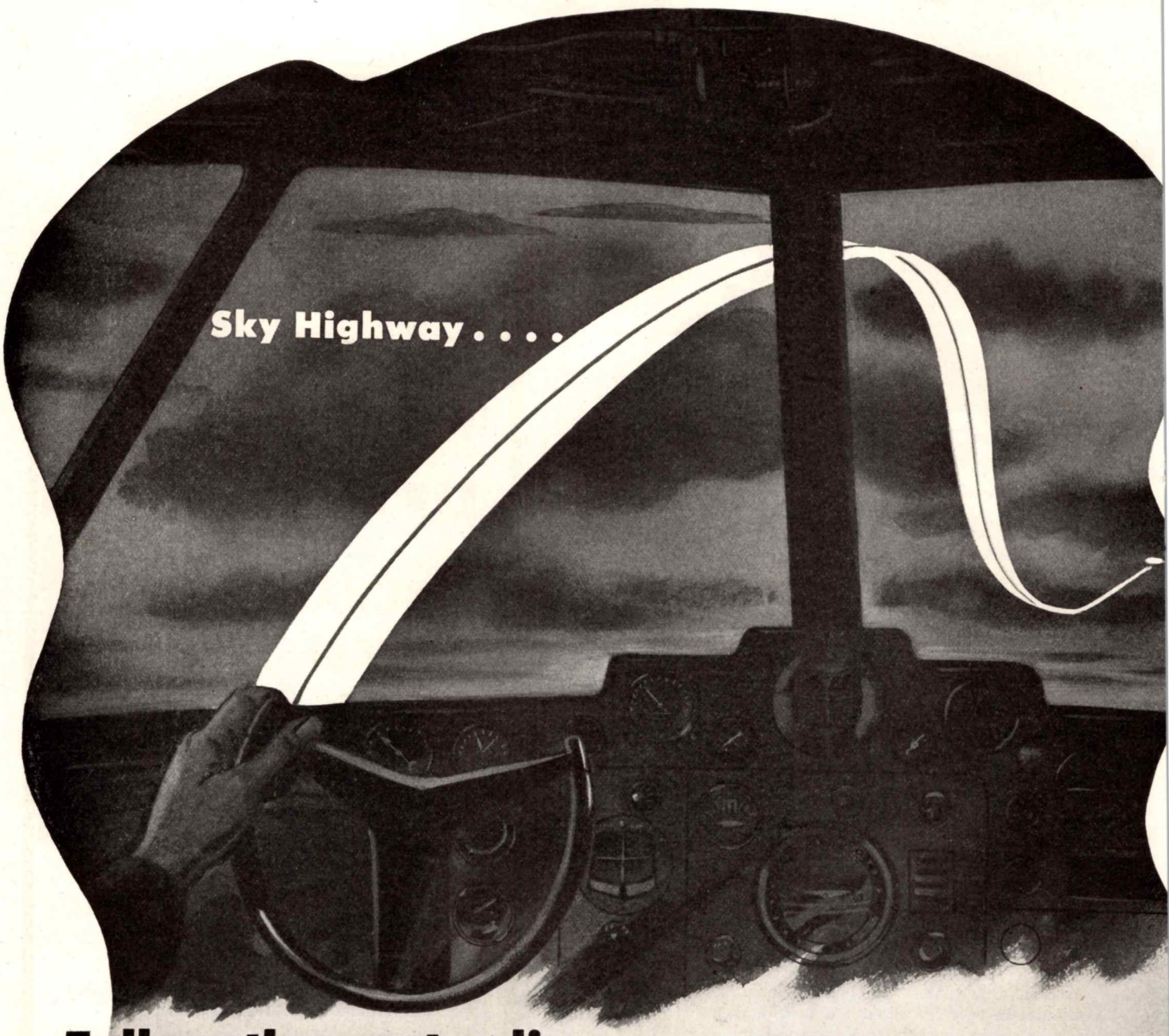
☆ BUY WAR BONDS ☆

General Electric Company, Air Conditioning and Commercial Refrigeration Divisions, Section 4311, Bloomfield, N. J.

Air Conditioning by

GENERAL ELECTRIC

Hear the General Electric Radio Programs: The "HOUR OF CHARM," Sunday 10 P. M., EWT, NBC..."THE WORLD TODAY" News, Every Weekday 6:45 P. M., EWT, CBS



Follow the center line . . .

The early birds who flew by the seat of their pants are fast fading away in the wake of the development of scientific flying. Gone are the days when a pilot had to feel his way to the air-port through pea soup fog.

The contribution of electronics to instrument flying is of first importance. Through radio communications, blind landing systems and a host of newer developments which cannot be revealed during wartime, air travel has rapidly blossomed.

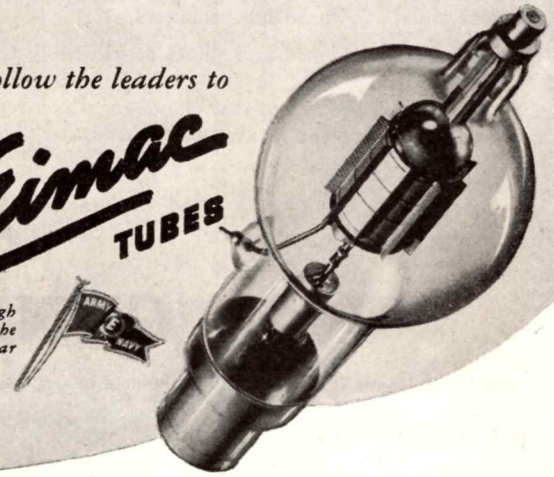
Yesterday Eimac electronic tubes earned their "wings" in the ground stations of the nations leading airlines. *Today* military aviation is building Eimac's flying hours to a record high. *Tomorrow* Eimac's new developments perfected and employed to win the war will be released to the tremendously expanded peace-time air services.

Eitel-McCullough, Inc., San Bruno, California

Follow the leaders to

Eimac TUBES

Awarded for high achievement in the production of war materials.



(*Continued from page* 412)

The Square D Co. has retired 1450 shares of 5% cumulative preferred stock as of June 30, leaving a total of 16,000 shares outstanding. Common stock amounting to 40,000 shares was reserved for conversion of the outstanding preferred stock on that date.

For the six months ended on June 30, 1943, Timken Roller Bearing Co., reports a net profit of $3,112,832 equal to $1.29 a share, subject to possible adjustment from renegotiation. In the same period last year the company netted $2,779,504 or $1.15 a share.

Dow Cumulative Pfd.

Stockholders of Dow Chemical Co. have set November 8 as the date for a meeting to vote on authorization of 600,000 shares of new cumulative preferred stock. The issue would be used to provide new working capital for anticipated future needs and to finance developments expected to take place in the chemical industry, officials state.

Consolidated Vultee declared dividends of 34¼ cents on preferred and 50 cents on common stock. The preferred dividend is payable December 1 on stock of record November 20, and the common November 15 to stock of record November 5.

Ryan Dividend

Ryan Aeronautical Co. on November 26 will pay a cash dividend of 35 cents per share to the stockholders of record October 26. This brings the total dividends for the current fiscal year to 45 cents per share, the same as for the 1942 fiscal year.

A dividend of fifty cents per share on the common stock of Northwest Airlines, Inc., has been declared by the directors of the corporation. This dividend represents a total amount of $117,460 and is payable to common shareholders of record as of Aug. 20.

New Thompson Pfd.

Prior preference and common stockholders of Thompson Products, Inc., will meet soon to authorize a new class of preferred stock of $4,500,000 par value to provide funds for post-war plans. Issuance requires approval of two-thirds of the combined prior preference and common shares. It would carry a dividend rate of not more than 5%.

Proceeds first would be applied to retirement of prior preference shares of which 25,660 now are outstanding, and the remainder added to capital.

20 Years Ago

From the 1923 Issues of AERO DIGEST

February

Count de Saint Aulaire, French Ambassador to London, with H. G. Wells made a flight from London to Paris last month. It is the first time the air route across the channel has been used by such a high official as an ambassador.

* * *

February

Flight asks the question: "Should the Civil Aviation Subsidy be spent on passenger-carrying machines or on the air transport of newspapers?" It would appear that to take away the subsidy from the passenger line and give it to a newspaper air service on the London-Paris route would not result in a better spending of the taxpayers' money.

* * *

March

The Post Office Department has announced that the mail airplanes will be equipped with snowshoes. Now if a pilot mistakes a snowdrift for a cloud he just unstraps his snowshoes from the plane and starts for the nearest town for aid.

* * *

April

Testing the possibility of refueling and of delivering messages from one airplane to another while in flight, Lawrence B. Sperry, using a Sperry *Messenger* which weighed less than 800 pounds, made contact with another plane eight times at different altitudes while flying 65 mph.

* * *

May

For boldness the Army Air Service sets a fast pace. Six planes left Kelly Field, Tex., to fly to San Juan, Porto Rico, by way of Cuba and Haiti with three stretches of water to cross.

* * *

September

By July 1930 at the latest, commercial aviation across the Polar Sea should be an accomplished fact. Alaska will then automatically become the greatest service station in the world.—Fitzhugh Green, USN in the *Times*.

New 16-Page Catalog
on
AIRCRAFT RELAYS
and ACCESSORIES...

★ This 16-page catalog gives operating characteristics, dimensional drawings, wiring diagrams, and general construction information on aircraft relays, contactors, solenoids and aircraft accessories. Among the relays described are five variations of the versatile B-2A Relay built to A.A.F. specifications.

In addition, there are several general purpose aircraft-radio relays; a tiny midget relay weighing less than an ounce; heavyweight and the new lightweight solenoid contactors (A.A.F. types A-3, B-4, B-5A, B-6A, B-7A); eight solenoids; six types of gun switch handles; a control wheel; propeller protractor; and a bomb and flare release.

A request on your company letterhead will bring this catalog to you.

Write Today

GUARDIAN ELECTRIC

1636-M W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

★ ★ ★ ★ ★ ★ ★ ★ ★

Good to the last JAP
SINCE
Brewster
1810
R. SOLTESZ
BUCCANEER AND BERMUDA DIVE BOMBERS • NAVY CORSAIR FIGHTERS

ABOUT PEOPLE

JOHN W. CROSS, for many years engaged in the practice of law in Washington, has been appointed general counsel of Mid-Continent Airlines, Inc. and will have jurisdiction over the company's legal activities in that city.

WILLIAM F. MCGRATH, formerly eastern regional traffic manager for Transcontinental & Western Air, Inc.. has been promoted to system traffic superintendent, with headquarters in Kansas City, Mo.

WILLIAM I. SELOVER, manager of the Los Angeles District office of the Sperry Gyroscope Co., has been presented a gold lapel pin studded with a diamond and rubies, signalizing 30 years of service with the company.

M. G. HUNTINGTON, division manager of the Washington office of B. F. Goodrich Co. for the past year, has been named an assistant manager of the company's National Sales and Service Division in Detroit. C. W. WACKER, a member of the original equipment division for the past five years has also been made an assistant manager in the Detroit district area. K. D. SMITH, in Detroit for the past year, returns to Washington as manager of Goodrich Government sales and service there.

WHITLEY B. MOORE has been appointed director of sales for all divisions of the Timken Roller Bearing Co. In his former position of general manager of sales of the steel and tube division, he is to be succeeded by C. H. MCCOLLAM, assistant general sales manager since 1940.

KENNETH HALL has been appointed factory representative in the midwestern territory for Snyder Tool & Engineering Co. Previous to his association with Snyder, Hall was process engineer at the Plymouth plant of Chrysler Corp. for eight years.

PAUL R. JORDAN, general manager of Harwill Corp., has been elected vice-president and general manager.

PAUL E. FLOYD, for more than a year with the iron and steel branch of the War Production Board, has returned to his former position as district manager in the Chicago office of the Allegheny Ludlum Steel Corp.

FRANK MCGOUGH, formerly reservations supervisor for TWA in Chicago, has been promoted to traveling reservations supervisor for the entire system. He has been succeeded at Chicago by PARKS GILMORE who joined TWA a year ago.

FRANK P. TIGHE has been named director of public relations and advertising for the Houdry Process Corp. Tighe comes to Houdry from the press division of the Office of Censorship, Washington, where he handled advertising and articles on industrial subjects.

ALAN G. DAY, has been made representative of Hamilton Standard Propellers at Wright Field, replacing SAMUEL P. CRAGO, veteran *Clipper* flyer who has been named materials manager of the division at East Hartford. Day has been chief engineer at Canadian Propellers, Ltd., Montreal for the past two years.

WILLIAM V. BROWN, for 34 years in the railway mail branch of the Post Office, has been appointed assistant director of post-war planning for Northeast Airlines. Brown initiated the make-up and dispatch of the first air mail schedules for this branch of the postal service in New England.

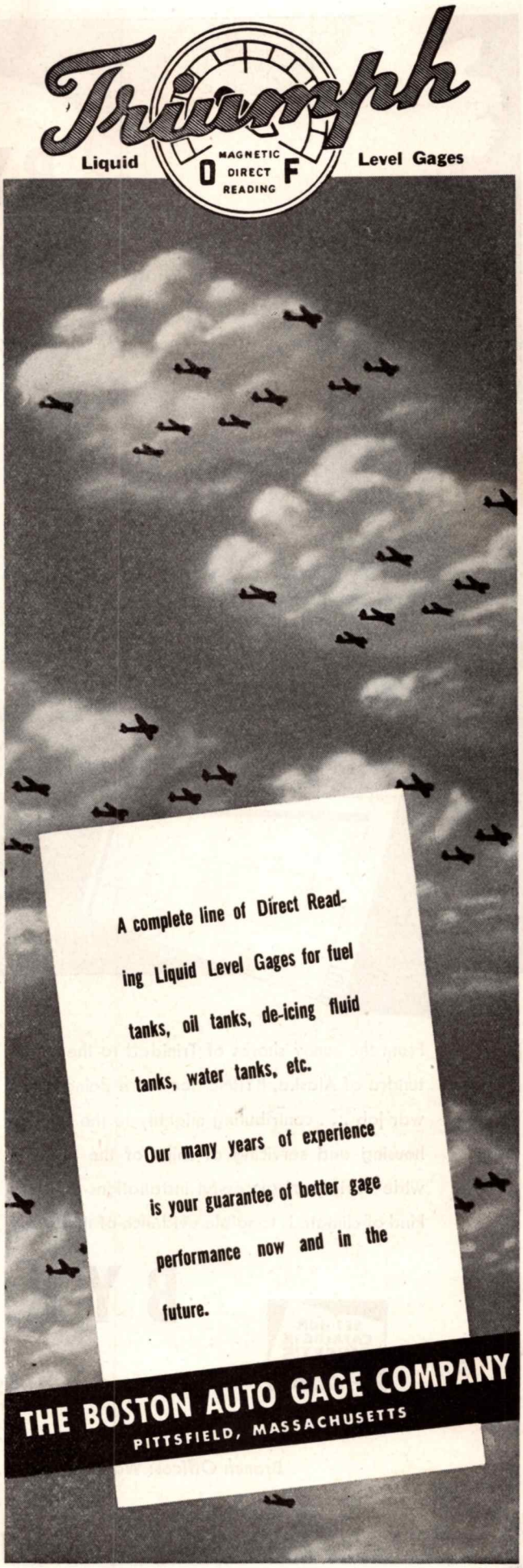
WILLIAM L. WILSON has been appointed assistant to the president of Kellett Aircraft Corp., having been director of industrial relations at the Farmingdale

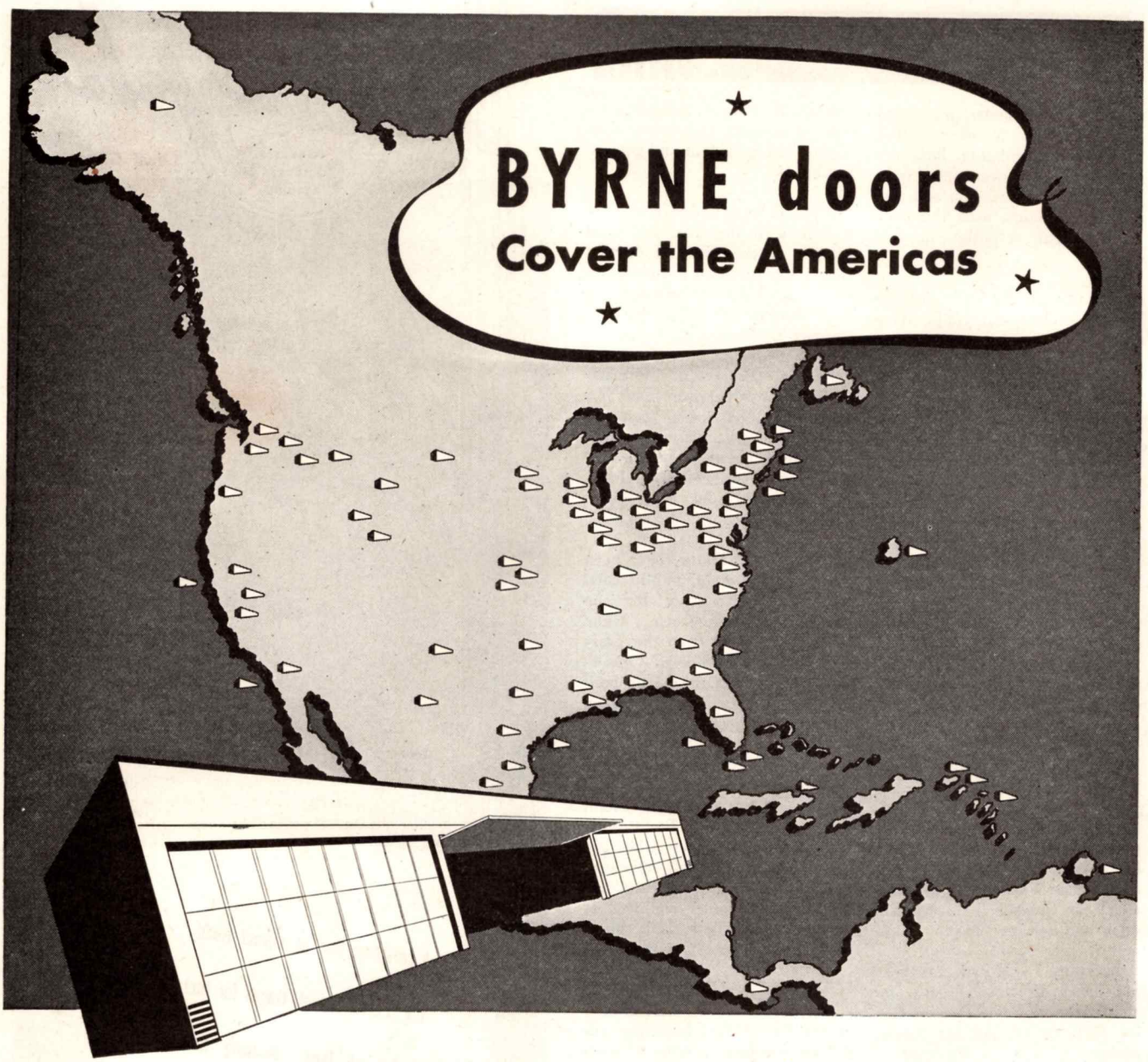
(*Continued on page* 419)

William I. Selover

William L. Wilson

K. D. Smith





From the sunny shores of Trinidad to the bleak tundra of Alaska, BYRNE doors are doing a big war job . . . contributing mightily to the speedy housing and servicing of ships of the air. The wide variety of successful installations in every kind of climate is tangible evidence of the ready adaptability of basic BYRNE door design to openings of every type and size.

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You are invited to bring your door problems to BYRNE engineers . . . the most widely consulted civilian authorities on hangar doors.

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Cable Address: *BYRNDOR*

***Branch Offices:* Washington, D. C. • San Francisco • New York**

BYRNE DOORS FOR OPENINGS OF EVERY TYPE AND SIZE

(*Continued from page* 417)
division of Republic Aviation Corp. Wilson is succeeded at Republic by MORGAN C. MONROE who joined the organization in May 1942.

MARY JACKSON, assistant to the director of industrial relations for Consolidated Vultee Aircraft Corp., is extending the company's new counselor training program, inaugurated at the San Diego division, to other divisions. THELMA SWANK has been named chief counselor of women at the San Diego division. Prior to joining the company she served seven years with the U. S. Employment Service.

CARL DOLAN has resigned as president and general manager of Commonwealth Aircraft, Inc., to become president of the Empire Research Corp. for Postwar Planning. Both organizations are under the same control.

C. V. TOPLIFFE, with Cutler-Hammer, Inc., since 1924, has been named manager of the Boston district office.

M. A. MOYNIHAN has retired as secretary and treasurer of Gemmer Manufacturing Co. after thirty-six years service with the company. Successors to Moynihan are GEORGE E. TRIMM, former assistant secretary and treasurer who becomes treasurer, and EDWARD P. HAMMOND, JR., secretary. Other changes in the organization recently are the promotions of CHARLES F. HAMMOND, JR., formerly experimental engineer, to vice-president in charge of engineering, and FRANK E. PHILLIPS, formerly assistant sales and export manager, to vice-president in charge of sales.

FRANK H. HARRISON, formerly manager of manufacturing for the International Harvester Co., and E. J. HARRINGTON, who has been coordinator of planning and production problems for Lockheed, have been elected vice-presidents of Curtiss-Wright Corp. Harrison has headquarters in the Columbus, Ohio, plant where he is in complete charge of operations. Harrington is located at the New York offices as a member of the executive manufacturing staff but is temporarily assigned to the Columbus factory.

P. F. ZERKLE is now directing sales activities of the Michigan Tool Co. Two new branch offices opened by the organization are at Cleveland with GEORGE PIERCE as district manager, and at Dayton with H. E. ROEDTER as district manager.

JOHN A. HUTCHESON, who helped design the world's most powerful broadcast transmitter at radio station WLW in Cincinnati, and for the last three years manager of engineering at the Baltimore radio division of Westinghouse Electric and Mfg. Co., has been appointed associate director of the Westinghouse Research Laboratories.

E. A. KEOGH has been named auditor of property for United Air Lines in charge of a new department operating within the company's treasury department at Chicago. Keogh, with the airline for 16 years, will have as his assistant, H. W. BENTSON, United veteran of 14 years service. H. DELANEY DILWORTH has joined United's Chicago offices as a rate and tariff analyst, a new position in the air transportation field created in view of the steadily increasing volume of wartime air shipments and the corresponding need for accurate information on rates.

C. W. PERELLE, San Diego vice-president in charge of manufacturing of Consolidated Vultee Aircraft Corp., has been elected a member of the board of directors. He fills a vacancy created by the resignation of G. M. Williams, one-time assistant to Board Chairman Tom M. Girdler.

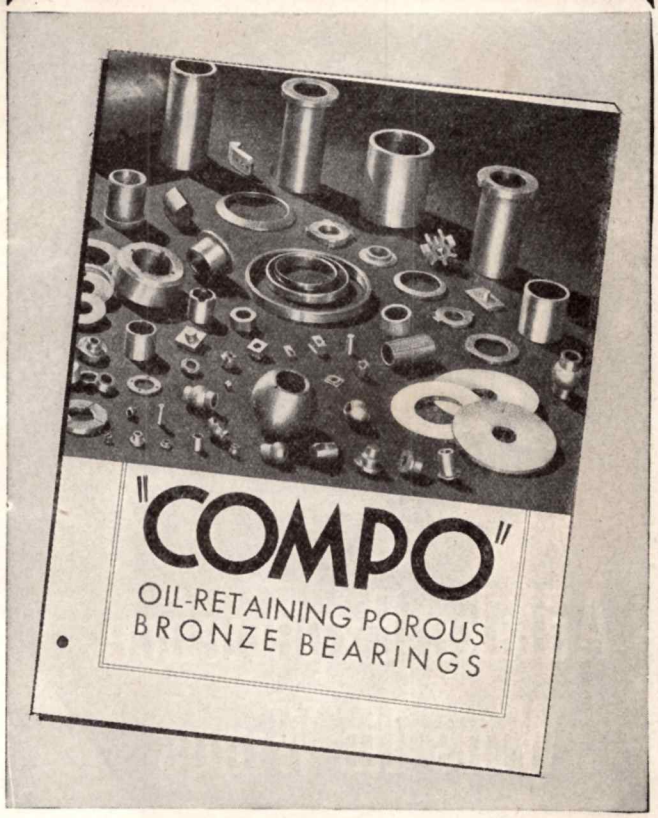
BERT BORCHERDT, who has been associated with Arens Controls, Inc., for the past two years, has been appointed manager of the west coast branch in charge
(*Continued on page* 423)

Frank H. Harrison

E. J. Harrington

Morgan C. Monroe

FOR BETTER MACHINES AND APPLIANCES



The latest "COMPO" Bulletin. Every designing engineer should have a copy. If time and materials are playing hob with your program, write for your copy today

For Long Life and Smooth Going!

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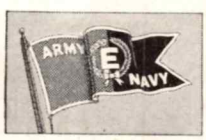
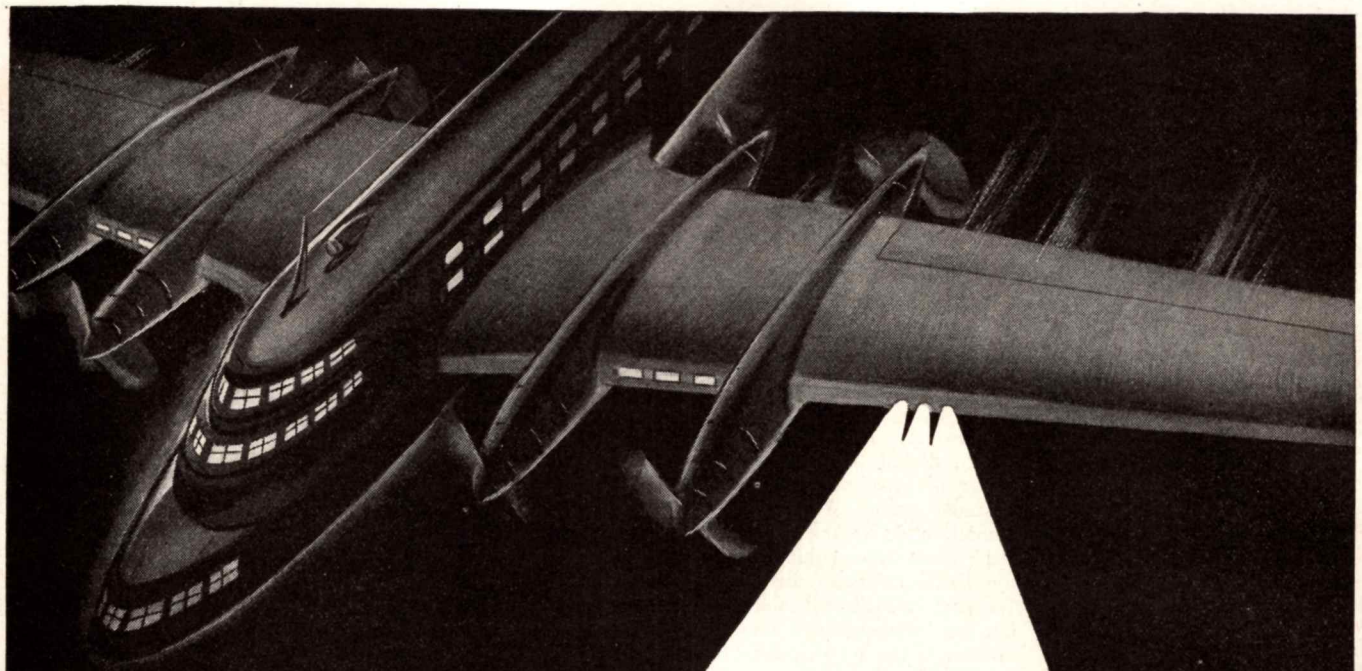
IMMEDIATE SHIPMENTS—hundreds of sizes in Stock
Diversification of sizes and shapes--thousands of tools on hand.
Engineered Sales • Continuous Research • Skilled Production.
Write for Bulletin, Stock List or Die List of Standard Shapes.



Bound Brook Oil-Less Bearing Co.
(Established 1883)
Main Office and Plant, Bound Brook, N. J.
Detroit, Michigan, 1255 Book Building
Los Angeles, Cal., 1901 Santa Fe Avenue

FOR BETTER MACHINES AND APPLIANCES



Adlake Experience Wins Its Wings

For many years Adams and Westlake has supplied the transportation and automotive industries with a major portion of their lighting fixtures, single and double glazed windows, window curtains, and metal specialties.

In this field Adams & Westlake manufacturing experience covers a period of more than four-score years.

Today, in ever increasing volume, we are manufacturing Lighting Fixtures and Accessories in accordance with N.A.F. and A.A.F. specification for the aircraft industry.

In addition, we have the plant capacity and equipment to meet the aircraft industry's needs for stamped and drawn parts in ferrous and non-ferrous metals, and for extruded and cast non-ferrous specialties.

Our staff of engineers is at your service —and we believe it can be of considerable help to you.

- **Instrument Board Lights** (*Direct and Indirect*)
- **Light Indicators**
- **Instrument Lights**
- **Running Lights**
- **Identification Lights**
- **Portable Lights**
- **Anchor and Identification Lights**
- **Electric Receptacles**
- **Sealed Beam Adapters**
- **Ash Receptacles**
- **Landing Lights and Lamps**
- **Windows and Curtains**
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ESTABLISHED IN 1857 **ELKHART, INDIANA** *NEW YORK · CHICAGO*

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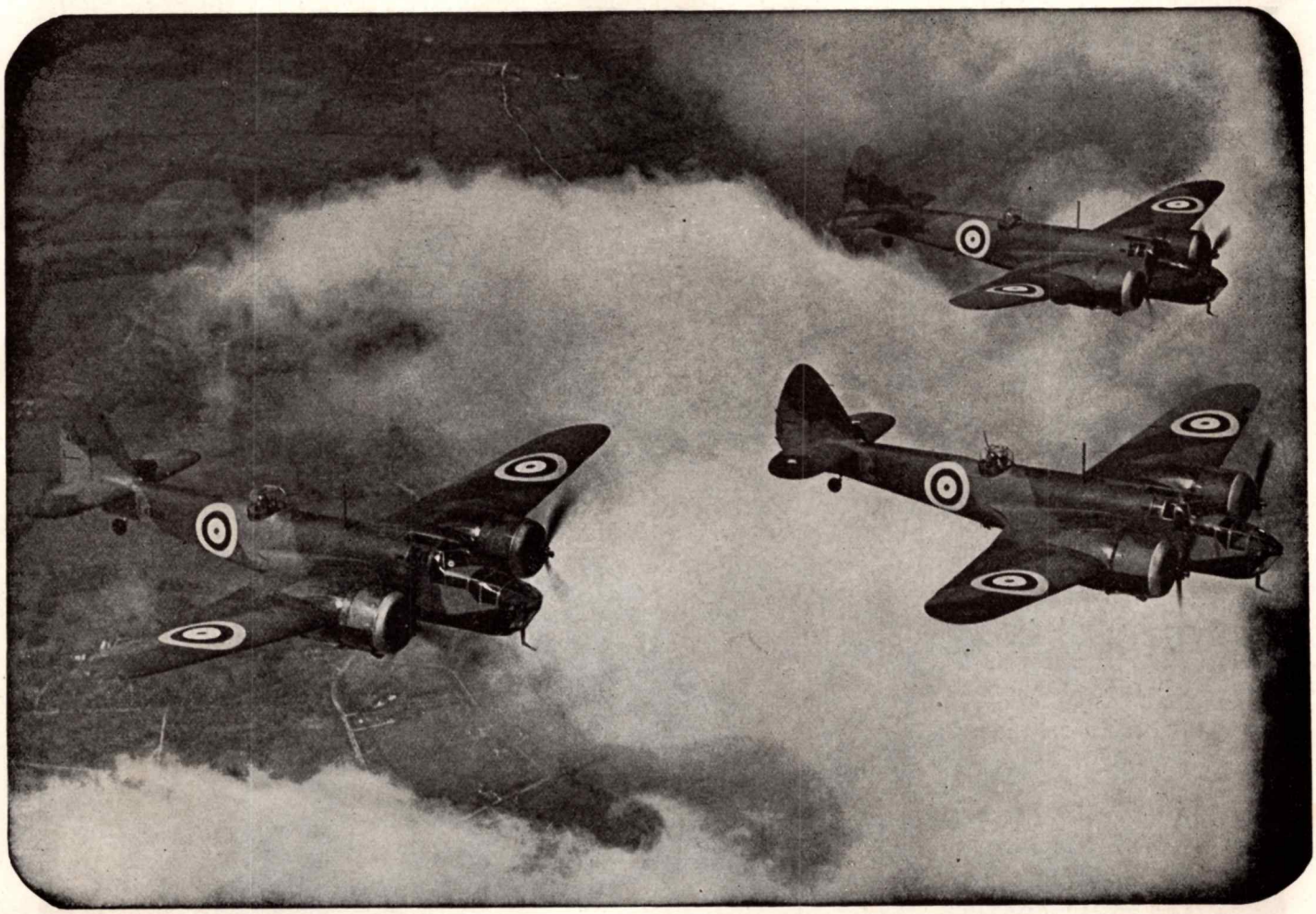

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You may avail yourself of the Weems System either through our home study course or through our individual or class instruction which is now provided in the following cities: Annapolis, Baltimore, Boston, Denver, Los Angeles, Miami, New Orleans, New York, Philadelphia, San Diego, San Francisco, Seattle, Springfield, Washington, D. C.

You who wish to further your present knowledge of navigation will find many of the texts and instruments used in the Weems System invaluable and may purchase these separately without necessarily taking the full air navigation course.

AIR NAVIGATION, Weems	$3.50
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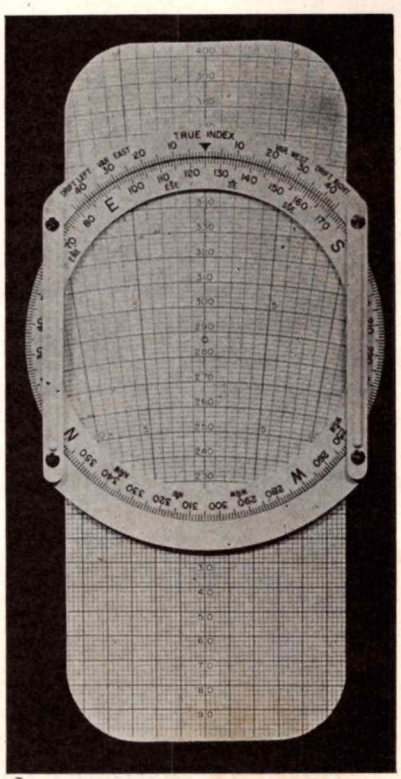
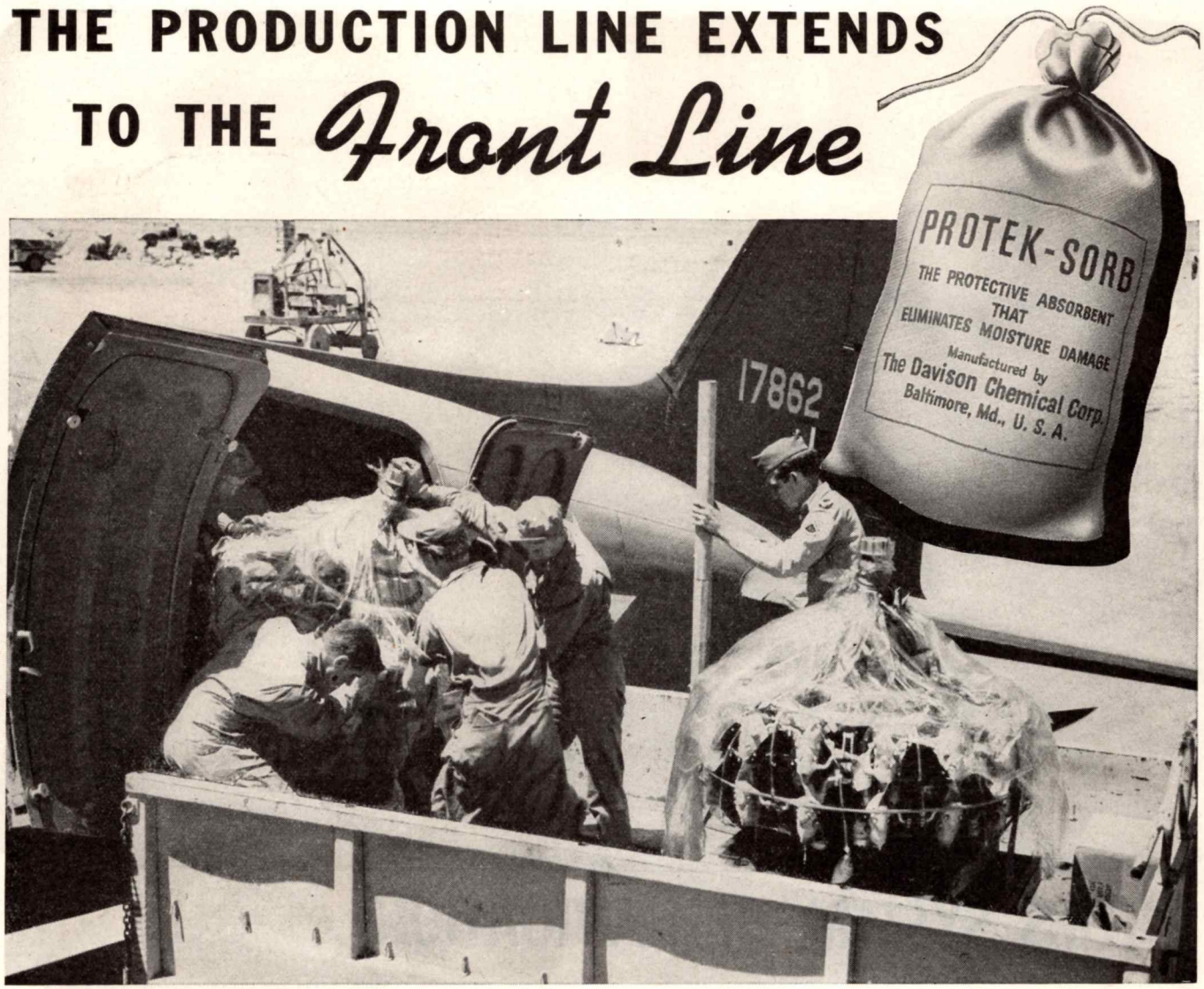
AIRCRAFT PLOTTER, MARK II	2.00
WSN COURSE AND DISTANCE PROTRACTOR	5.00
DALTON COMPUTERS, MARK VII OR E-1A	7.50
DALTON COMPUTER, E-6-B	10.00
BROWNELL-WEEMS STAR FINDER	5.00
SPEED-TIME-DISTANCE CALCULATOR	1.00
LYON COMPUTER, U.S. Coast & Geodetic Survey Type	3.00
GILLMER COMPUTER	3.00
SEA AND AIR RESIDENCE AND HOME STUDY COURSES	Various

WEEMS SYSTEM OF NAVIGATION, Annapolis Maryland



Dalton Computer, E-6-B, "Standard with Navy and Army Air Force."

THE PRODUCTION LINE EXTENDS TO THE *Front Line*



Packing by Method II, in which Davison pioneered, makes scenes like the above possible. Complete engines arrive at the battle front free of rust and free of slushing compounds, ready for immediate use without the waste of time in deslushing oils and grease.

Davison Protek-Sorb Silica Gel insures against rust and corrosion because it removes the cause —moisture vapor. The engine or spare parts from the time they leave the factory until they reach their destination are sealed in an atmosphere where rust and corrosion are impossible . . . because Davison's Protek-Sorb has removed all the moisture vapor from the packages.

Davison science and research have seen the job through. The task is not finished when the engine or part leaves the factory; it must be preserved right up to the place where it is needed.

Davison Protek-Sorb Silica Gel is today successfully used to package

Complete Engines

Cylinders (run-in, with piston and ring)
Crank and propeller shafts
Carburetors, pumps, magnetos
Engine Superchargers
Propeller parts
Governors and Aircraft Instruments
Complete Airplanes
50 caliber machine guns
Bomb sights
Tanks
Directors
Fire Control Assemblies

THE DAVISON CHEMICAL CORPORATION

BALTIMORE 3, MARYLAND

Progress through Chemistry

Lee Swigart

James S. Lincoln

James E. Webb

(*Continued from page* 419)

of contact operations. PHILIP HOOKER has been appointed sales and advertising manager of Arens. He comes to the company from Bell Aircraft, where he was executive assistant manager of the contracts department.

LEE SWIGART, district traffic manager in the New York area for TWA, has been promoted to Eastern regional traffic manager. Swigart has been in the airline's employ since 1929.

R. F. TUCKER and ADOLPH FRANKEL have been named staff assistants to the manager of the Westinghouse Lamp Division, with headquarters at Bloomfield, N. J., and will assist in coordination of manufacturing, engineering and sales activities of the four lamp division plants. Tucker joined Westinghouse in 1909, while Frankel came to the company in 1917.

CARL R. ANDERSON, who was associated from 1929 to 1937 with Embry-Riddle company, has rejoined the organization as assistant vice-president. Anderson has been a public relations director for Pan American Airways in Los Angeles since his previous connection with Embry-Riddle.

JOHN H. SPADE has been named an assistant treasurer of United Aircraft Corp., with assignment to the Sikorsky Aircraft division. Spade joined United in April, 1941.

W. W. GALBREATH has been appointed executive vice-president of the Pressed Metal Institute and will give special attention to post-war problems and planning.

JAMES E. WEBB, formerly secretary and treasurer of Sperry Gyroscope Co., has been elected vice-president of the company and will continue to serve as secretary. FREDERIC W. KILDUFF, formerly assistant treasurer, has been promoted to treasurer.

JOSEPH T. HARTSON, formerly executive vice-president of The Glenn L. Martin Co., has assumed the position of president of the Glenn L. Martin-Nebraska Co. Hartson began his career in the aviation industry in 1917 with Boeing, later joining Wright Aeronautical and in 1935 the Martin organization.

CHARLES YOUNG has been appointed personnel director of Aerco Corp. CHARLES CROWTHER has been named plant superintendent of the company.

JAMES S. LINCOLN, for ten years manager of the industrial department of the Minneapolis Civic and Commerce Association and secretary of the aviation committee, has joined the staff of Northwest Airlines and will do special research work for the company.

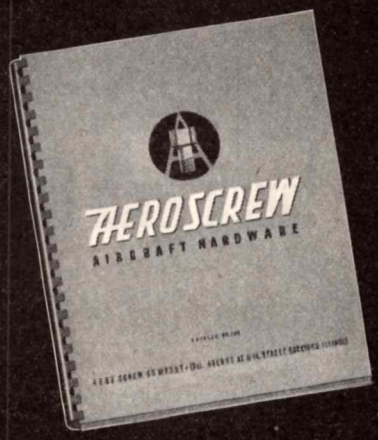
H. V. GAERTNER, assistant controller of B. F. Goodrich Co. since 1929, has been appointed assistant treasurer, succeeding EDWARD M. MARTIN, now in overseas service in the international sales division.

CHARLES D. TRUMAN, for many years serving General Motors Products of Canada as account executive with the MacLaren Advertising Co. Ltd. of Toronto, has been appointed public relations director of Interstate Aircraft and Engineering Corp.

JOHN EASTON has been named director of the development and standardization activities of the Whiting Corp., Harvey, Ill., succeeding A. J. BROWN who has been transferred to the post of manager of the Pacific Coast Branch. Easton was formerly chief of the technical development division of the CAA.

ALEXANDER KENNEDY, JR., has been named assistant to the manager of the Federal and marine divisions of General Electric Co., in charge of engineering. HOWARD P. BISH also has been appointed an assistant to the manager of the same divisions in charge of administrative affairs.

WRITE FOR OUR NEW CATALOG...



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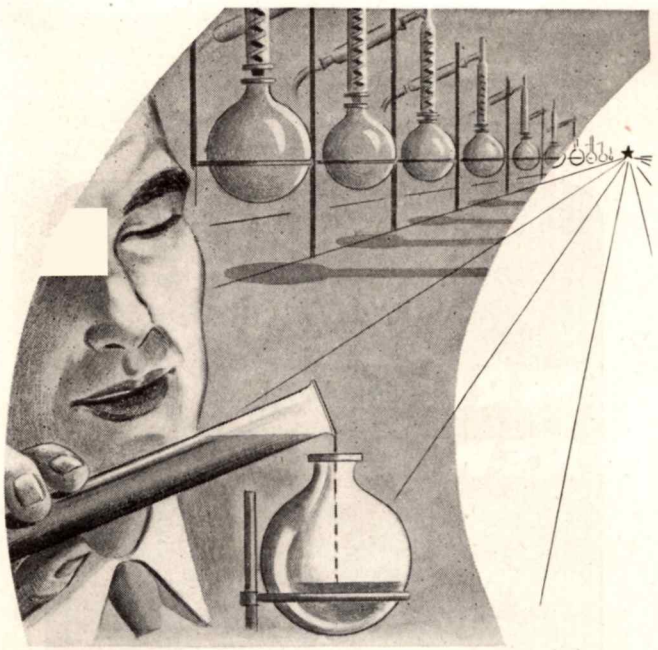

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Upon such discoveries, Sperti, Inc. has been built.

For Sperti is more than the manufacturer of *SUN LAMPS, IRRADIATION LAMPS, FLUORESCENT LIGHTING, MEAT TENDERIZERS* and the much-publicized *BIO-DYNE OINTMENT.*

It is more than the maker of *SPERTI'S ELECTRONIC DEVICES* and *NAVIGATION INSTRUMENTS.*

Beyond Sperti there are laboratories devoted to pure scientific research, staffed by scientists wholly devoted to exploring new fields of knowledge.

Many of their studies yield results which have immediate practical application.

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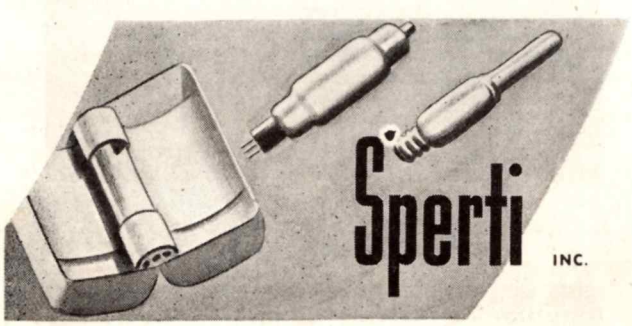
Even now, though almost wholly occupied with war work, Sperti may have an advancement applicable to your business.

And just ahead may lie other discoveries of vital importance to you.

It will pay you to consult Sperti now—as you plan your postwar products.



RESEARCH, DEVELOPMENT, MANUFACTURING • CINCINNATI, OHIO

J. I. Hamilton

Charles J. Hodge

Stephen B. Mambert

STEPHEN B. MAMBERT, formerly an executive of the Kingsburg Ordnance plant, has been appointed assistant to the president of Republic Aviation.

J. I. HAMITON, with Curtiss-Wright's propeller division since 1938 and recently has held the post of administrative engineer, has been promoted to assistant to R. Elmer Minton, manager of the military programs for the propeller division at Caldwell, N. J.

CHARLES J. HODGE, recently associated with the office of the Secretary of War and earlier with United Airlines, has been appointed assistant director of industrial relations for Republic Aviation's Indiana division.

PAUL HEINECK has been appointed midwest hydraulics representative of Bendix Aviation, Ltd., in the area bounded by Ft. Worth, Nashville, Chicago, and New Orleans, with headquarters at Normandie, St. Louis County.

THOMAS O'MALLEY has assumed the duties of division manager, New England, of the Industrial Pneumatic Tool division of Aro Equipment, while JAMES LITTLETON has been named division manager in the Southern Ohio territory.

J. M. JOHNS has been named general manager of industrial sales of Libbey-Owens-Ford Glass Co., succeeding the late G. L. Conley. Johns joined the company in 1922 and in that time served as a representative in Europe.

JULES GRATIOT has been appointed sales manager of the Air-Maze Corp.

W. E. ADDICKS has been named manager of the New York district of Cutler-Hammer, Inc., and in his new duties will have direct supervision of sales in this territory. Addicks, with the organization since 1914, was in charge of the Boston office prior to his new appointment.

THOMAS R. COFFEY has been named manager of sales of the Wisconsin-Minnesota district of the Globe Steel Tubes Co., with headquarters at Milwaukee.

S. R. KALLENBAUGH has been named West Coast district manager of the steel and tube division of Timken Roller Bearing Co., with offices in Los Angeles. Until assuming this post he was metallurgical service representative for Timken in Cleveland and Detroit.

JOHN H. WILSON has assumed the duties of executive director of the National Aviation Training Association succeeding C. R. MOONEY who resigned as secretary to become personal representative of the president of Parks Air College. Mooney was appointed chairman of NATA's legislative committee while the post of secretary-treasurer has been taken over by Mrs. ENA L. PUGH, former office manager in Kansas City.

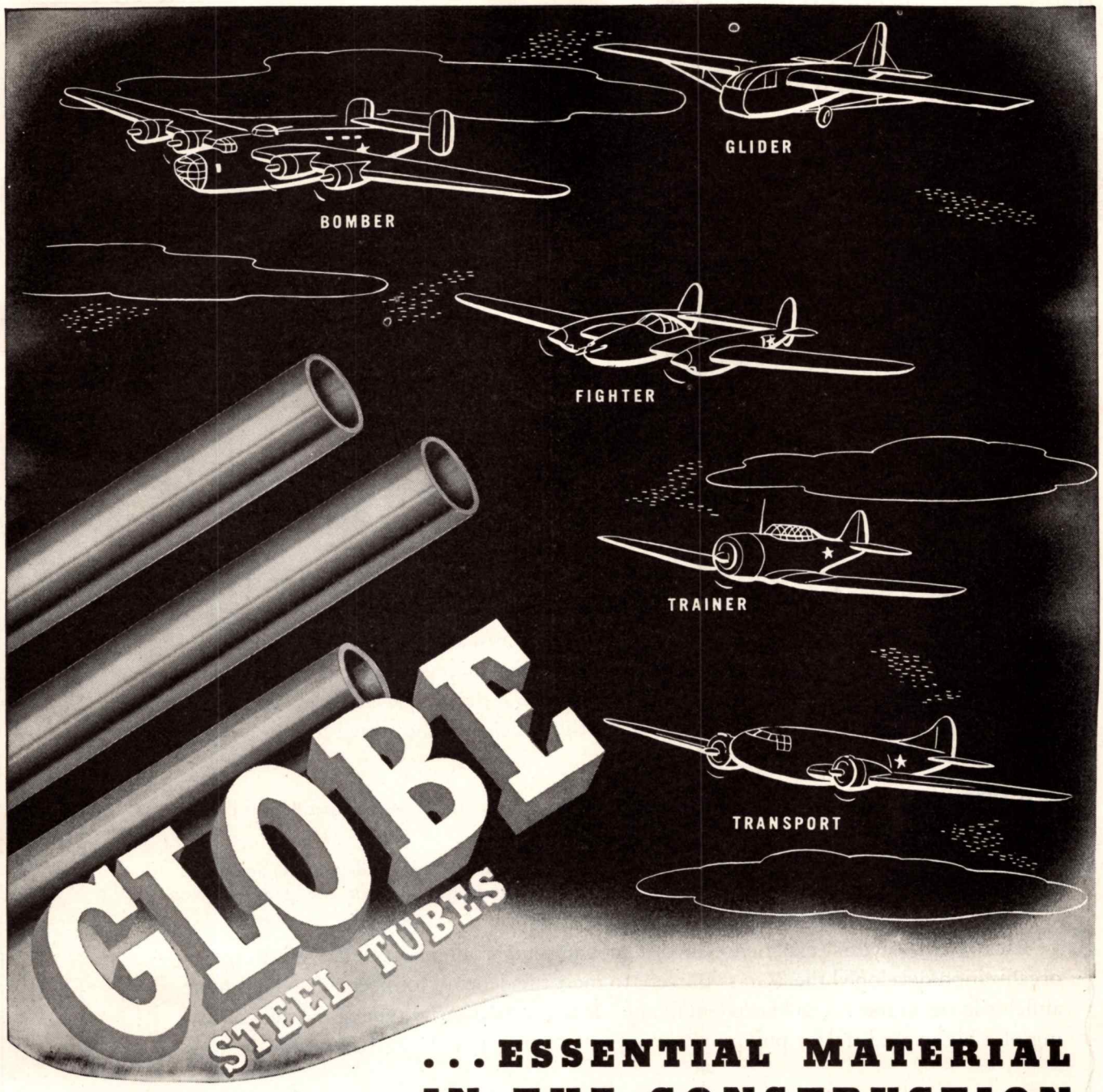
RUSSELL E. DILL has been appointed chief administrative manager and S. D. HACKLEY, chief

(*Continued on page* 427)

Jules Gratiot

J. M. Johns

Paul Heineck



...ESSENTIAL MATERIAL IN THE CONSTRUCTION OF MODERN AIRCRAFT

MORE than 83 different parts used in modern aircraft construction involve the use of Globe Steel Tubes — including Globe seamless carbon, alloy and stainless steel tubes, as well as Gloweld welded stainless steel tubing.

Great structural strength with minimum weight—adaptability and easy machine-ability — uniformity — qualify Globe steel tubes for applications ranging from small stator shells in fractional horsepower motors, as used aboard planes, to sturdy cylinders required for hydraulic landing gear.

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- Stainless Tubes (Seamless)
- Gloweld Tubes (Welded Stainless)
- Globeiron Tubes (Seamless Pure Iron)

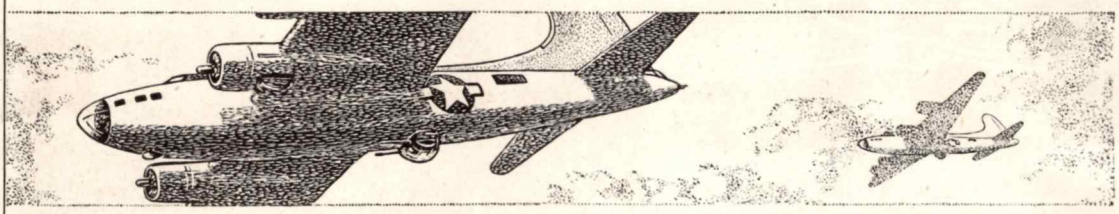
Carbon — Alloy — Stainless Steels

GLOBE STEEL TUBES CO. MILWAUKEE, WIS., U. S. A.

WORTHINGTON

AIRFIELD

"GRASS BLITZER"



keeps today's huge airfields in "fighting trim"

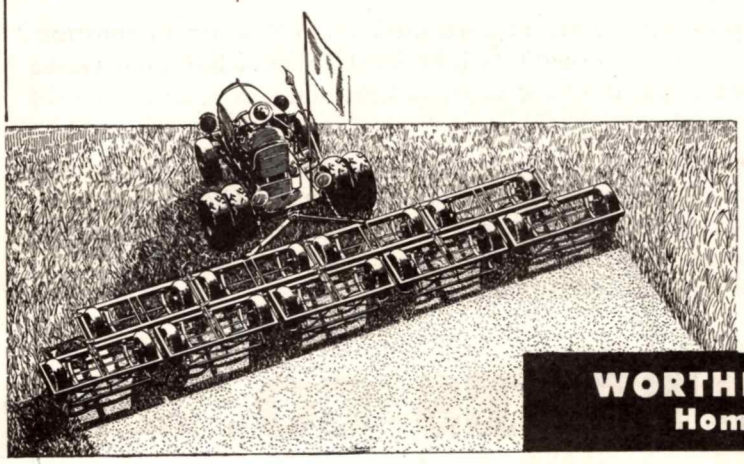
Airfields, like fighters and bombers, must be kept in "fighting trim." The turf must be cut regularly — experts advise 10 to 15 times a season depending on the climate — to assure the best and safest take-off and landing conditions. And just as speed in flying fighters and bombers is all-important today . . . so is speed a vital necessity in mowing airfields.

Speed and efficiency . . . the reasons the Worthington Airfield "Grass Blitzer" is the only gang mower being purchased today for use on the airfields of the armed forces. Look at these figures . . . they speak for themselves:

OLD TYPE LAWN OR GOLF COURSE GANG MOWER: maximum acreage cut per 8-hour day — approximately 88 acres.

NEW WORTHINGTON "GRASS BLITZER": average acreage cut per 8-hour day — 300 acres . . . more than three times the cutting capacity of any other combination tractor and gang mower now available.

Backed by 30 years' experience in turf mowing and maintenance, the Worthington organization developed the "Grass Blitzer" to meet the demand for keeping today's huge airfields in condition . . . to "keep 'em flying." It is a revolutionary type of mower consisting of a high speed tractor pulling a 9-gang unit cutting a swath 21.1 feet wide.



Since July 26th the Army-Navy "E" pennant has been flying over our plant . . . a tribute from the armed forces to our employees, to our suppliers and to our customers without whose wholehearted co-operation our full-out wartime production would not be possible.

WORTHINGTON MOWER COMPANY
Home Office: Stroudsburg, Pa.

M. N. Trainer

Luther H. Atkinson

Dr. Edward E. Minor Jr.

(*Continued from page* 424)
operations manager of the Fleetwings division of Kaiser Cargo. Frank De Ganahl, former vice-president and general manager, has resigned because of ill health.

HARRY M. SHEALEY, former factory manager for Glenn L. Martin's Omaha plant, has been named assistant vice-president in charge of production for Globe Aircraft Corp., Fort Worth, Tex.

JOHN M. MILLER has been named factory manager of the Los Angeles plant of United States Rubber Co. Miller formerly held the same post at the Marion, Ohio munitions plant which is operated by the company for the Government.

WILLIAM D. KENNEDY, vice-president of Wright Aeronautical, has been appointed general manager of the Lockland plant. W. W. FINLAY, manager of that plant since it began operations in 1940, was made director of industrial relations with headquarters in Paterson, N. J.

M. N. TRAINER has been elected first vice-president of the American Brake Shoe Co. A vice-president since 1933 and president of the company's Brake Shoe and Castings Division since 1939, he will continue as president of that division.

LUTHER H. ATKINSON has been appointed vice-president in charge of sales of the Elastic Stop Nut Corp. of America. Atkinson was formerly vice-president in charge of marketing for the Weyerhaeuser Sales Co.

DONALD E. SHARP, formerly assistant to the vice-president and director of research of the Hartford-Empire Co., has joined the Libbey-Owens-Ford Glass Co., and has been named assistant director in charge of glass technology. DR. ROY W. WAMPLER has been promoted to assistant director in charge of product research.

RALPH C. STUART has been appointed manager of the lamp division of the Westinghouse Electric and Manufacturing Co., with headquarters in Bloomfield, N. J. With the company for 25 years, he came to his present headquarters from the plant at Hamilton, Ontario, where he had been manager.

LLOYD L. MILLER is the new manager of the U. S. Plywood Plant, New Rochelle, N. Y., having formerly been in charge of production control and engineering planning for the woodworking department of Western Electric Co. Miller was associated with Western Electric for the last eight years and previously was connected with the Whittelsey Co., makers of laminated airplanes.

JOSEPH T. OGLE, formerly field service supervisor for Glenn L. Martin, has been appointed assistant service manager of Fairchild Aircraft division in charge of field service. GEORGE W. DRESS, JR., has also joined Fairchild as assistant service manager, coming to the company from General Motors Corp. KENT BRADFORD will continue as manager of the service division. Transferred from the Hagerstown plants to the Burlington branch plant where he will supervise spare parts distribution and service activities on the Fairchild AT-21 *Gunner*. GLEN EVINS is manager of contracts and service department for both the Hagerstown and Burlington plants of Fairchild.

R. K. MOORE, of United Air Lines' accounting department for 15 years, has been appointed general purchasing agent, succeeding E. VAN VECHTEN who has resigned to become western representative of the Weatherhead Co., at Los Angeles.

DR. EDWARD E. MINOR JR., who has been elected a vice-president of All American Aviation Inc., will head the newly formed manufacturing and development division of the company. Before joining All American Dr. Minor was development and design engineer with Glenn L. Martin.

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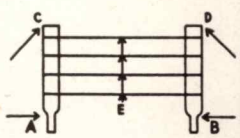
C & D	185° F.
E	450° F.



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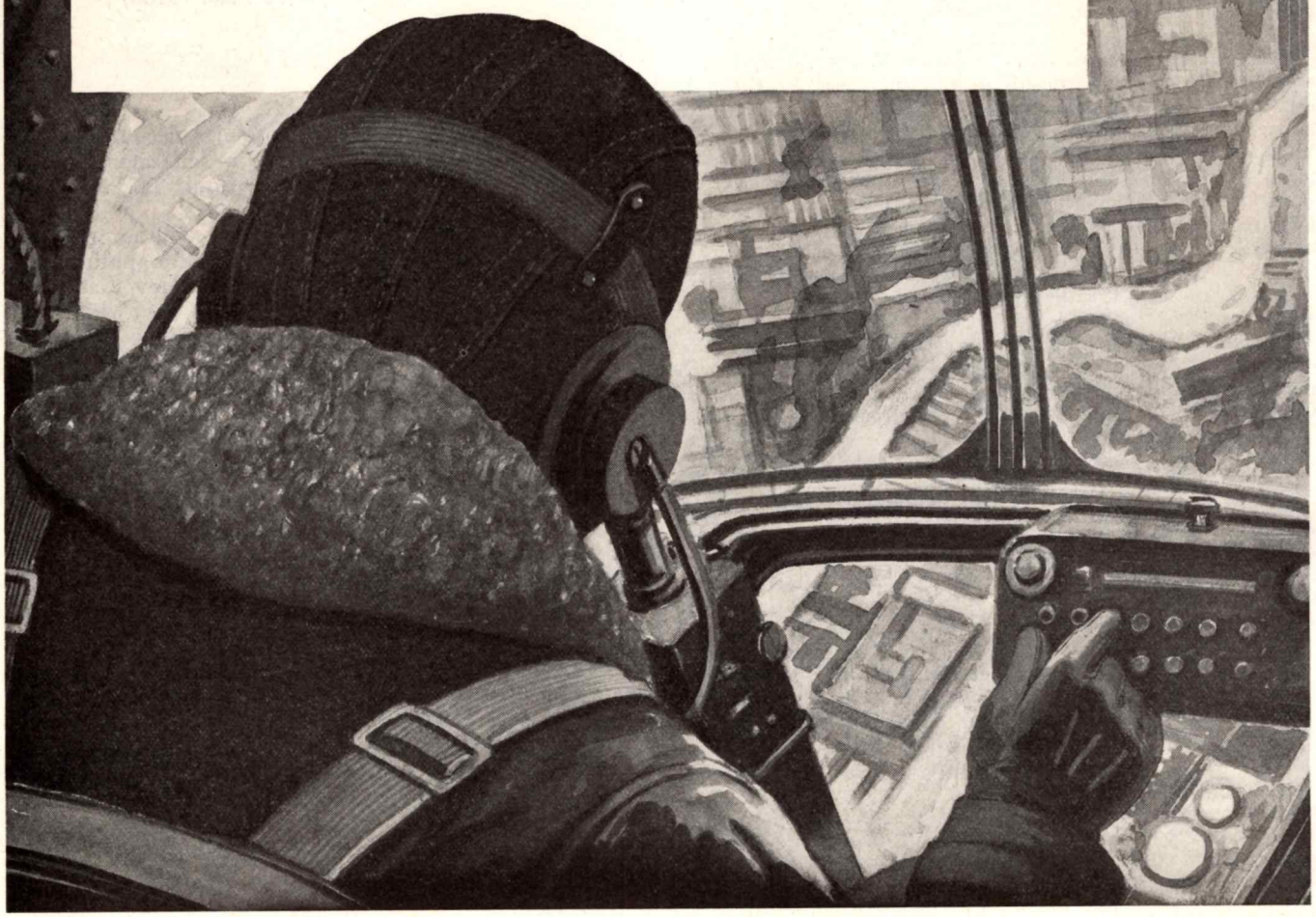

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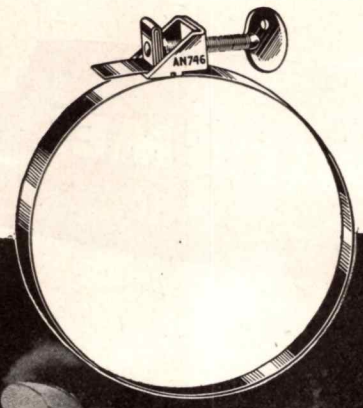

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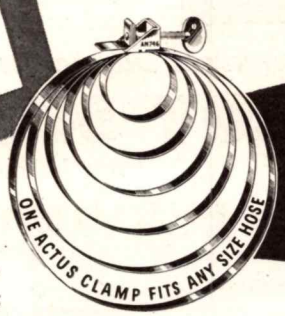

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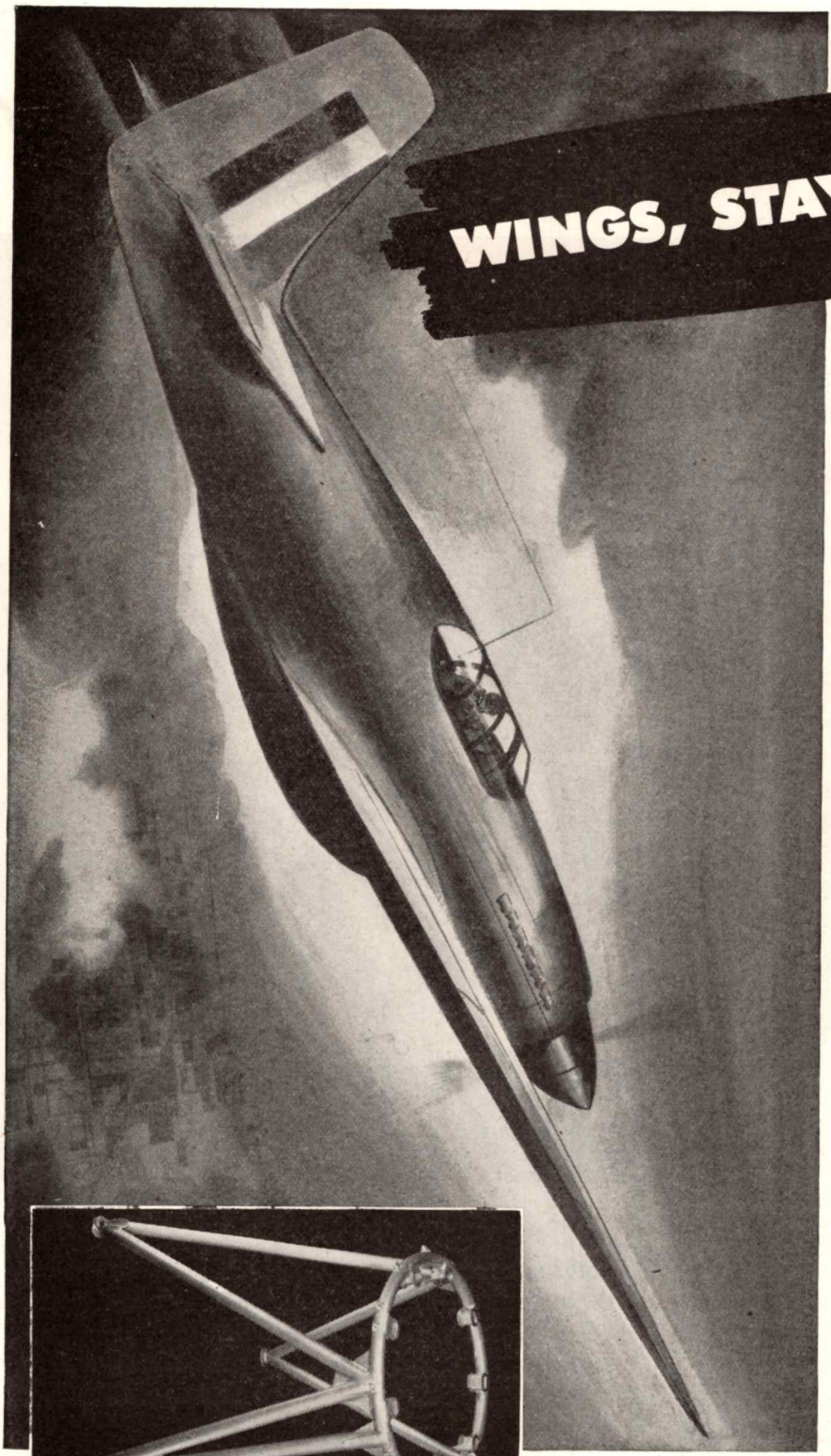

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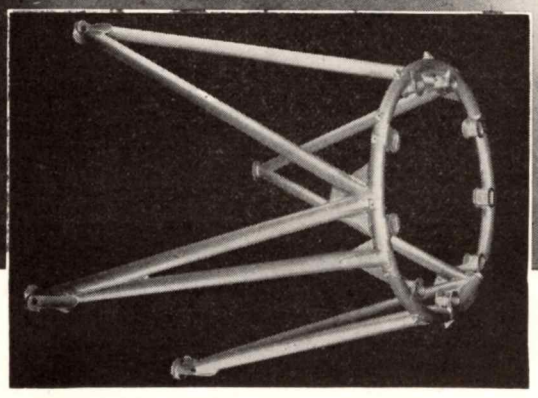

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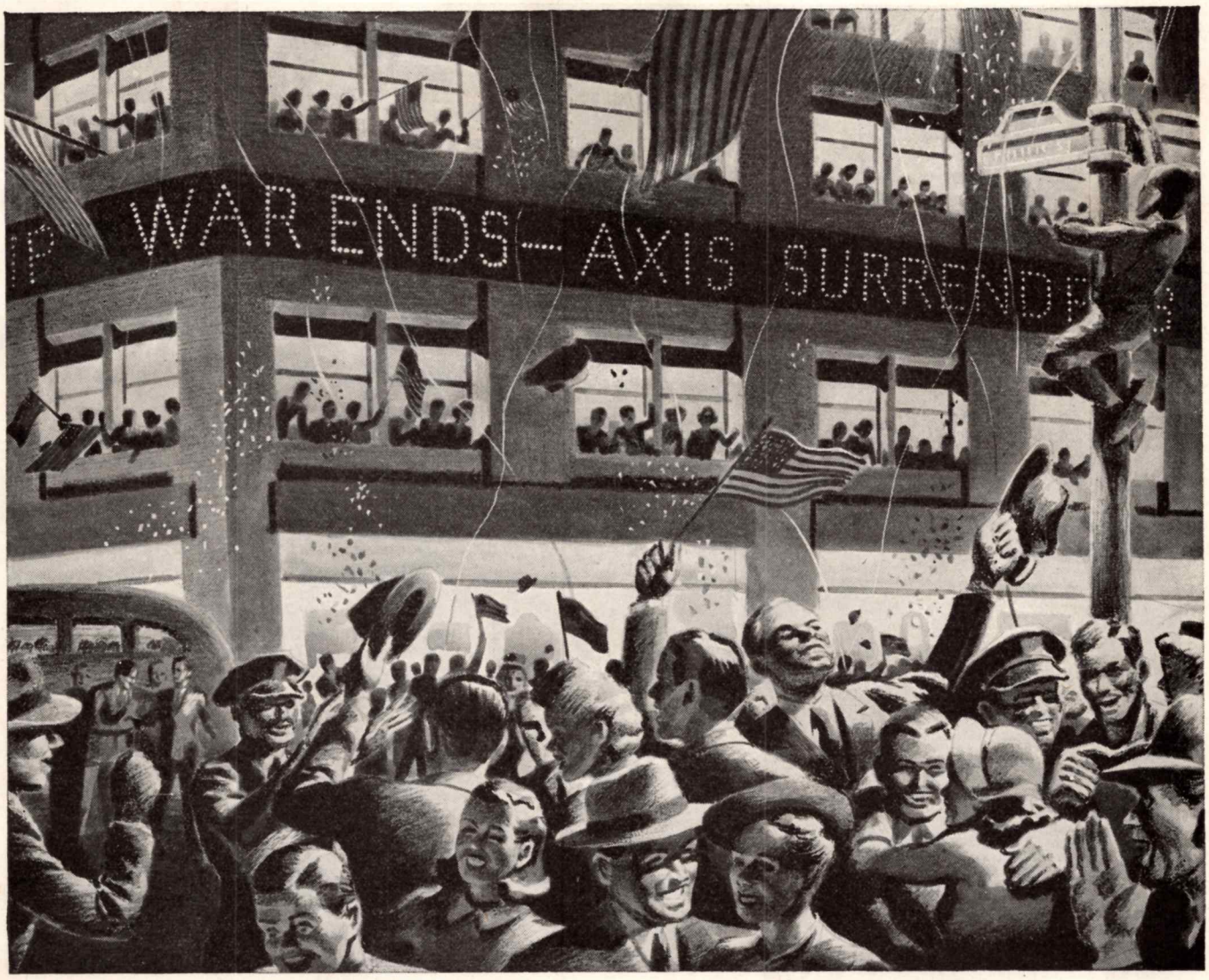

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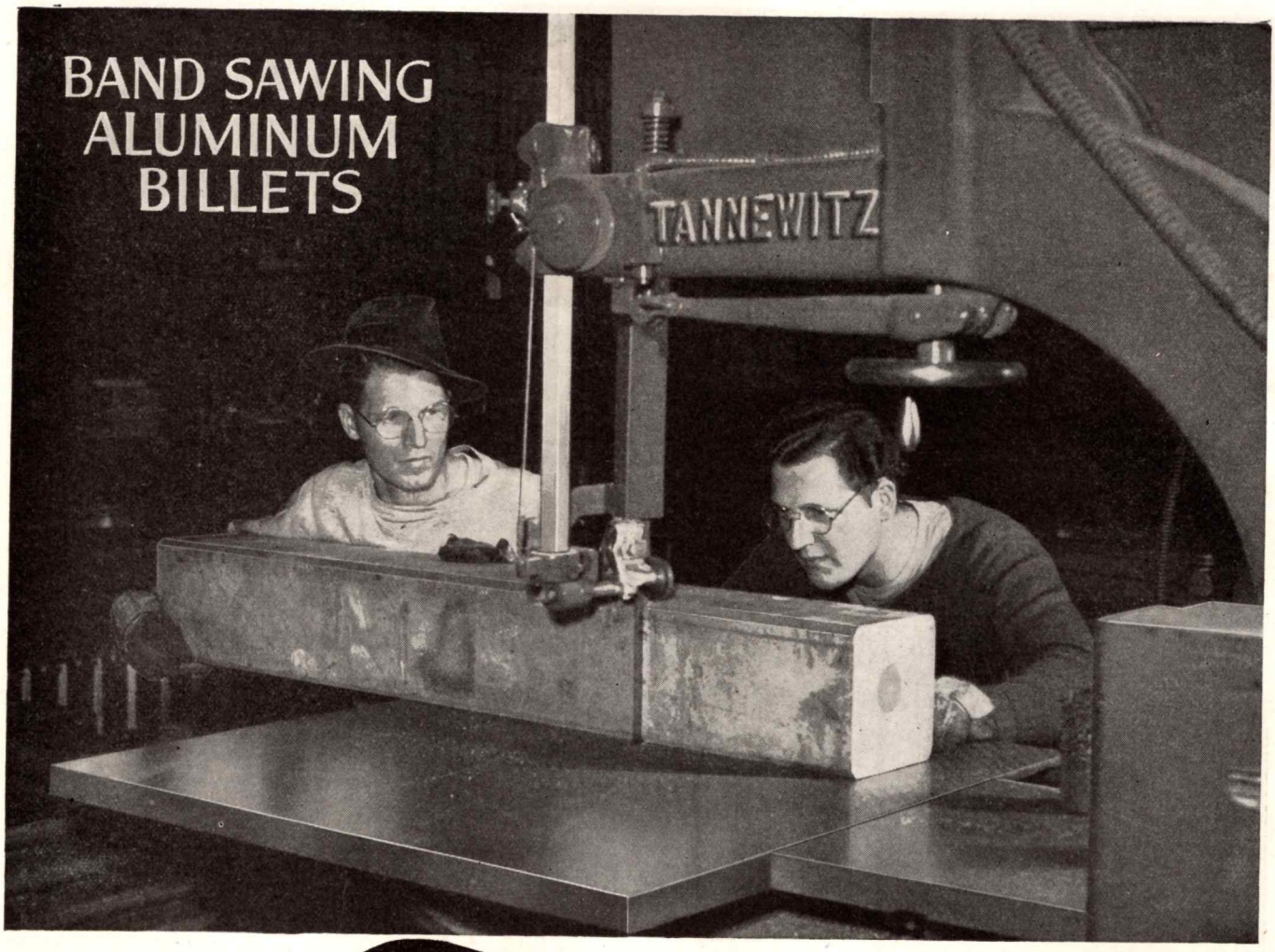

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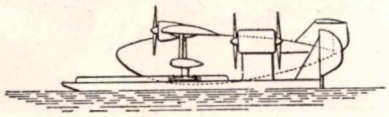
These patents, of interest to the aeronautical industry, were compiled from recent issues of the *Official Gazette* of the U. S. Patent Office. Copies of the individual patents, in pamphlet form, may be obtained from the Commissioner of Patents, Washington, D. C., at a cost of ten cents each

Variable Pitch Aerial Propeller. Morris Levine, New York, N. Y., assignor of one-half to Sigmund Einstoss, Brooklyn, N. Y. (2,327,274)

Rotary Wing Aircraft. Frank A. Howard, Elizabeth, N. J. (2,330,056) (See illustration)

Fin Construction. Charles E. Lucke, New York, N. Y., assignor to United Aircraft Corp., E. Hartford, Conn. (2,330,065)



2,331,837

Motor Synchronizer. Erle Martin, W. Hartford, and Frank W. Caldwell, Hartford, Conn., assignors to United Aircraft Corp., E. Hartford, Conn. (2,330,070)

Marker for Aircraft Landing Stations. Eugene D. Waters, Buffalo, N. Y., assignor to Max D. Farmer, E. Aurora, N. Y., as trustee. (2,330,096)

Reflecting Unit. Eugene D. Waters, Buffalo, N. Y., assignor to Max D. Farmer, E. Aurora, N. Y., as trustee. (2,330,097)

Cartridge Case. Ernest C. Bomar, U. S. Army, Philadelphia, Pa. (2,330,200)

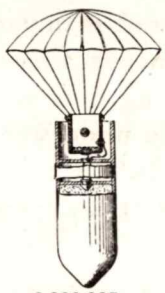
Multirotor Aircraft. Harris S. Campbell, Bryn Athyn, Pa., assignor to Autogiro Co. of America, Philadelphia, Pa. (2,330,204) (See illustration)

Blank Ammunition Firing Attachment for Gas Operated Guns. John C. Garand, Springfield, Mass., assignor to the Government of the United States of America, as represented by the Secretary of War and his successor in office. (2,330,210)

Reinforced Metal Covering for Aircraft. Paul H. Kemmer, Fairfield, Ohio. (2,330,219)

Quickly Removable Boot. Leslie H. L'Hollier, Waltham, Mass., assignor to the B. F. Goodrich Co., New York, N. Y. (2,330,224)

Device for Measuring Gas Leakage. Melville F. Peters, Beltsville, and John P. Boston, Garrett Park, Md. (2,330,236)



2,330,325

Power Lift Device. James Morkoski, Canton, Ill., assignor to International Harvester Co. (2,330,303)

Explosive-Carrier Sensitive to Airplane Induced Aerial Disturbances. George F. Archer, New York, N.Y. (2,330,325) (See illustration)

Machine Gun. Smith B. Howe, Grand Island, N. Y., assignor to Bell Aircraft Corp., Buffalo, N. Y. (2,330,362)

Power Transmission. Harry Orner, Cleveland Heights, Ohio. (2,330,374)

Automatic Power Transmission. Harry Orner, Cleveland Heights, Ohio. (2,330,375)

Bomb. Henry Stieb, Berkey, Ohio. (2,330,393) (See illustration)

Hand Grenade. Earl Douglas Hibbs, Philadelphia, P. (2,330,490)

Process of Welding Metals Electrically. Antonio Longoria, S. Euclid, Ohio. (2,330,503)

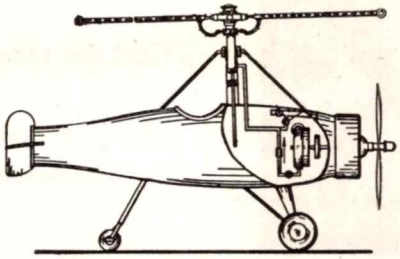
Method of Fabricating Piston Rings. Thomas A. Bowers, Mettapoisett, Mass., assignor to Power Research Corp., Boston, Mass. (2,330,549)

Ring Means for Pistons. Thomas A. Bowers, Mattapoisett, Mass., assignor to Power Research Corp., Boston, Mass. (2,330,550)

High Altitude Fuel System for Aircraft. Russell R. Curtis, Dayton, Ohio, assignor to Curtis Pump Co., Dayton, Ohio. (2,330,558)

Apparatus for Controlling Land, Marine, and Aerial Vehicles. Robert Esnault-Pelterie, Boulogne-Billancourt, France; vested in the Alien Property Custodian. (2,330,569)

Toolhead for Rifling Machines. Frank O. Hoagland, W. Hartford, Conn., assignor to Niles-Bement-Pond Co., W. Hartford, Conn. (2,330,584)



2,330,056

Nozzle Illuminating Means. John F. Kendrick, Columbus, Ohio, assignor to International-Stacey Corp., Columbus, Ohio. (2,330,592)

Arc Welding Low-Carbon Steel with a Carbon Electrode. Bernard M. Larsen, Elizabeth, N. J., assignor to U. S. Steel Corp. of Del. (2,330,601)

Angle Measuring Instrument. Paul A. McNally, Washington, D. C. (2,330,603)

Elevator for Repetition and Automatic Firearms. Gino Revelli, Rome, Italy; vested in the Alien Property Custodian. (2,330,626)

Aerial Bomb. Howard Smith, Bryn Mawr, Pa. (2,330,636) (See illustration)

Welding Device. John C. Albright, Chicago, Ill., assignor to The Dole Valve Co., Chicago, Ill. (2,330,658)

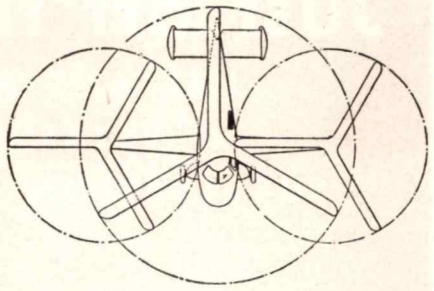
Mechanism for Improving the Dirigibility of Ships, Submarines, and Aircraft. Henry C. Briggs, Brooklyn, N. Y. (2,330,674)

Catalyst. Gerald C. Connolly, Baton Rouge, La., assignor to Standard Oil Development Co. (2,330,685)

Cartridge Fuse and Switchgear Incorporating the Fuse. Kurt Dannenberg, Islington, London, Eng., assignor of one-half to Electric Transmission Ltd., Etruria, Stoke-on-Trent, Staffordshire, Eng. (2,330,690)

Hose Nozzle. Alfred L. Grise, Springfield, Mass., assignor to Gilbert & Barker Mfg. Co., W. Springfield, Mass. (2,330,704)

Method of Magnesium Production. Russell H.McCarroll, Dearborn, Frank G. Shaub, Detroit, and Joseph S. Laird, Dearborn, Mich., assignors to Ford Motor Co., Dearborn, Mich. (2,330,724)



2,330,204

Shock-Withstanding Bearing. Frederick William Meredith and Francis Henry Owens, London, Eng., assignors to S. Smith & Sons (Motor Accessories) Ltd., Cricklewood, London, Eng. (2,330,729)

Air Terminal Take-Off Device. Joseph Olaszy, New York, N. Y. (2,330,733)

Rifle Mechanism. John D. Pedersen, Jackson, Wyo. (2,330,737)

Hydraulic Braking System. Emil H. Piron, New York, N. Y., assignor to Transit Research Corp., New York, N. Y. (2,330,739)

Air-Cooled Engine Cylinder. Alfred T. Gregory and Chester C. De Pew, Farmingdale, N. Y., assignors to Fairchild Engine & Airplane Corp., Farmingdale, N. Y. (2,330,779)

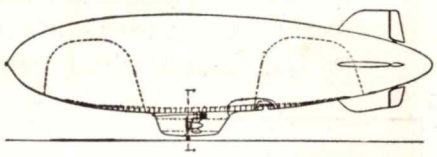
Fire Protection Outfit. Edison L. Wheeler, Wilmette, Ill. (2,331,283)

Catalysts and the Preparation Thereof. Raymond C. Archibald, Contra Costa Co., and Albert E. Smith, Berkeley, Calif., assignors to Shell Development Co., San Francisco, Calif. (2,331,292)

Veneer Press. Vincent Bendix, South Bend, Ind., assignor, by mesne assignments, to Langley Aviation Corp., New York, N. Y. (2,331,296)

Veneer Press. Vincent Bendix, South Bend, Ind., assignor, by mesne assignments, to Langley Aviation Corp., New York, N. Y. (2,331,297)

Plotting Device. Hubert Bennett, U. S. Army. (2,331,298)



2,331,404

Life Preserver. Frederick Lee Brown, Greenfield, Ohio, assignor to The American Pad & Textile Co., Greenfield, Ohio. (2,331,301)

(*Continued on page 437*)

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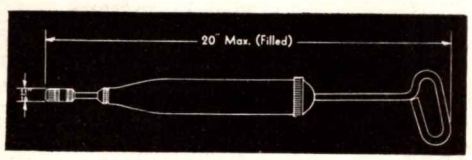

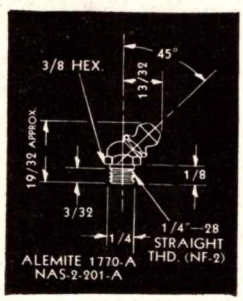

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(*Continued from page* 435)

Life Preserver. Frederick Lee Brown, Greenfield, Ohio, assignor to The American Pad & Textile Co., Greenfield, Ohio. (2,331,302)

Synthetic Flight Trainer. Edmund O. Carmody, U. S. Navy. (2,331,303)

Wing Lift and Aileron Illustrator. Edmund O. Carmody, U. S. Navy. (2,331,304)

Emergency Exit Catapult. Loren E. Curriston, Marne, Mich. (2,331,309)

Nut Anchor. Frederick R. Heinick, Los Angeles, Calif., assignor, by mesne assignments, to Lester E. Hutson, Los Angeles, Calif. (2,331,322)

Pneumatic Tire. Charles J. Jahant, Akron, Ohio, assignor to The General Tire & Rubber Co., Akron, Ohio. (2,331,323)

Method of and Apparatus for Making Rivets. John Jay Jakosky, Lawrence, Kans. (2,331,324)

Plastic Composition. Lucas P. Kyrides, Webster Groves, Mo., assignor to Monsanto Chemical Co., St. Louis, Mo. (2,331,328)

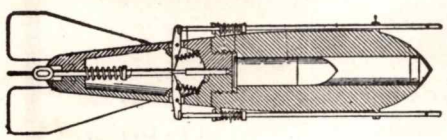
Cellulosic Plastic Composition. Lucas P. Kyrides, Webster Groves, Mo., assignor to Monsanto Chemical Co., St. Louis, Mo. (2,331,330)

Firearm. Per Harry Erik Rehnberg, Enskede, Sweden, assignor to Aktiebolaget Snabb Av Ar 1938, Stockholm, Sweden. (2,331,347)

Brake Shoe Mounting. Steve Schnell, Kirkwood, Mo., assignor to Wagner Electric Corp., St. Louis, Mo. (2,331,349)

Riveting Machine. Clyde Thiele, Hampton, Va. (2,331,359)

Mechanical Gun and Projector. Russell L. Baldwin, Findlay, Ohio, and John B. Chapman, Stamford, Conn., assignors to Remington Arms Co., Inc. (2,331,368)



2,330,393

Firearm. Andrew E. Buchanan, Jr., Fairfield, Conn., assignor to Remington Arms Co., Inc. (2,331,372)

Firearm. Elias I. Kelsey, Milford, Conn. assignor to Remington Arms Co., Inc. (2,331,400)

Airship. Herman R. Liebert, Akron, Ohio, assignor, by mesne assignments, to Wingfoot Corp., Akron, Ohio. (2,331,404) (See illustration)

Firearm. Crawford C. Loomis, Ilion, N. Y., assignor to Remington Arms Co., Inc. (2,331,405)

Ammunition gaging Machine. Warren S. Reynolds, Stratford, Conn., assignor to Remington Arms Co., Inc. (2,331,422)

Product Containing Zein and Process of Making Same. Richard R. Sitzier, Cumberland, Md., assignor to Celanese Corp. of America. (2,331,434)

Aircraft Armament. Croydon H. A. Hartley, Garden City, N. Y., assignor to Republic Aviation Corp. (2,331,470)

Method of Producing Guns. Alexander W. Keema, Providence, R. I. (2,331,477)

Method and Apparatus for Welding. Malcolm S. Clark, Warren, Ohio, assignor to The Federal Machine & Welder Co. (2,331,537)

Engine Crankshaft. Julius Dusevoir, Dearborn, Mich., assignor to Century Motors Corp., Dearborn, Mich. (2,331,541)

Method of Production of Engine Cylinders. Finn T. Irgens, Wauwatosa, Wis., assignor to Outboard, Marine & Mfg. Co., Milwaukee, Wis. (2,331,554)

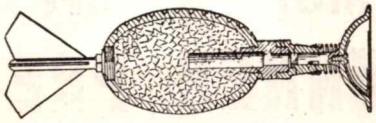
Method of Making Composite Articles. Arthur F. Underwood, Detroit, Mich., assignor to General Motors Corp., Detroit, Mich. (2,331,584)

Pedal Structure for Educational Airplane-Cockpit Outfits. Sam Gold, Chicago, Ill., assignor to Einson-Freeman Co., Inc., Long Island City, N. Y. (2,331,605)

Plastic Composition. Kenneth E. Marple, Oakland, and Frankin A. Bent, Berkeley, Calif., assignors to Shell Development Co., San Francisco, Calif. (2,331,614)

Marksmanship Instruction Attachment for Firearms. Paul Minghetti, Stockton, Calif. (2,331,616)

Magnetic Field Responsive Device. David W. Moore, Jr., New York, N. Y., assignor to Fairchild Aviation Corp. (2,331,617)



2,330,636

Brake Mechanism. Lawrence R. Buckendale, Detroit, Mich., assignor to The Timken-Detroit Axle Co., Detroit, Mich. (2,331,652)

Aircraft. Francis William King, New Maiden, Eng. (2,331,837) (See illustration)

Designed to Lift, Remove and Remount Airplane Wheels 30" to 56" Diameter

The Weaver Airplane Wheel Dolly permits one man to lift heavy wheels from the floor and place them on the spindle or to remove wheels and transport them to service departments. Screw jack raises lifting arms so wheel is exact spindle height. Dolly is mounted on casters and wheel is "aimed" at spindle through hub. Chain holds wheel upright or permits slight tilting to right angle with axle. For the production line or service shop. Write for complete information to...

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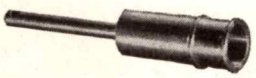
Low in cost, economical to operate. Fast—can be "set up" for any size in its range in less than a minute.

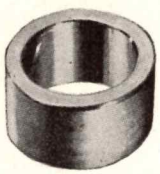
Let a Sunnen engineer check *your* job in your plant with this equipment—or write for bulletin giving complete information.

The coveted Army-Navy "E" waves over the Sunnen plant—evidence of the important part Sunnen equipment is playing in the war effort.



Carbureter Idler Valve Jet. Hole is honed after reaming for smooth action.

Cast Iron Valve Stem Guide. 1/2 to one thousandth removed—220 pieces per hour. Better finish and straighter hole.



Roller Bearing Outer Race. Finish improved from 12 micro inches to 2 micro inches.

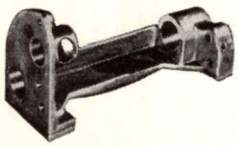
Idle Control Valve Seat. Due to large "windows," almost impossible to get straight round hole by grinding. Sunnen solved the problem.

Bearing. A very small part. 2 micro inch finish necessary.

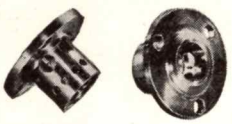
Hydraulic Valve. Previous method of grinding threw radius on edge of "windows." Sunnen honing eliminated trouble.

Aircraft Valve Tappet Roller. Honed after grinding to give 100% bearing surface.

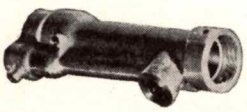
Hydraulic Metering Valve Stem. Hole .156″ in diameter; reamed, heat treated, and then honed. Honing 3 times as fast as previous method.



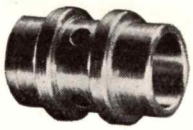
Wing Bracket. Two 3/4″ holes must be in line. Honing increased bearing surface and reamer life.



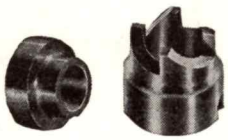
Stainless Steel Load Compensator Valve Seat. Hole is honed to .0002″ limit.



Aircraft Hydraulic Brake Cylinder. Honing three times faster than lapping—and gave a straighter hole.

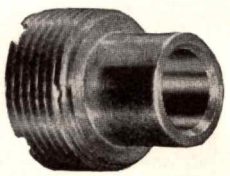


Hydraulic Two-Way Control Valve. Hole is honed to eliminate leakage.

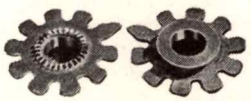


Aircraft Instrument Panel Control Wire Bushing. Hole .187″ diameter—held to .0002″, stock removal .001″, sixty per hour.

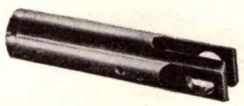
Counterbore Cutter. Very small part and because of this fact hard to handle by any other method.



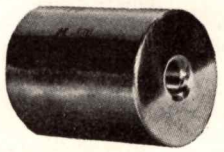
Pump Shaft Bushing. Bronze; honing follows reaming. Sunnen method greatly reduced valve leakage.



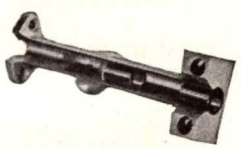
Calculator Machine Gears. Cut from hole which is reamed and then honed. Honing maintains same pitch line concentricity.



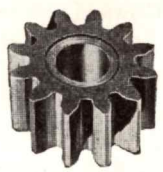
Aircraft Valve Guide. Valve tappet roller pin hole honed to 6 micro inch finish.



Header Die. Life of header dies increased 3 to 9 times over lapping. Knock out pin breakage practically eliminated.



Carbureter Metering Jet. Two black bushings Bakelite. Line honing by Sunnen method.



Spur Gear. By honing gears direct from heat treatment, concentricity of pitch line is maintained.

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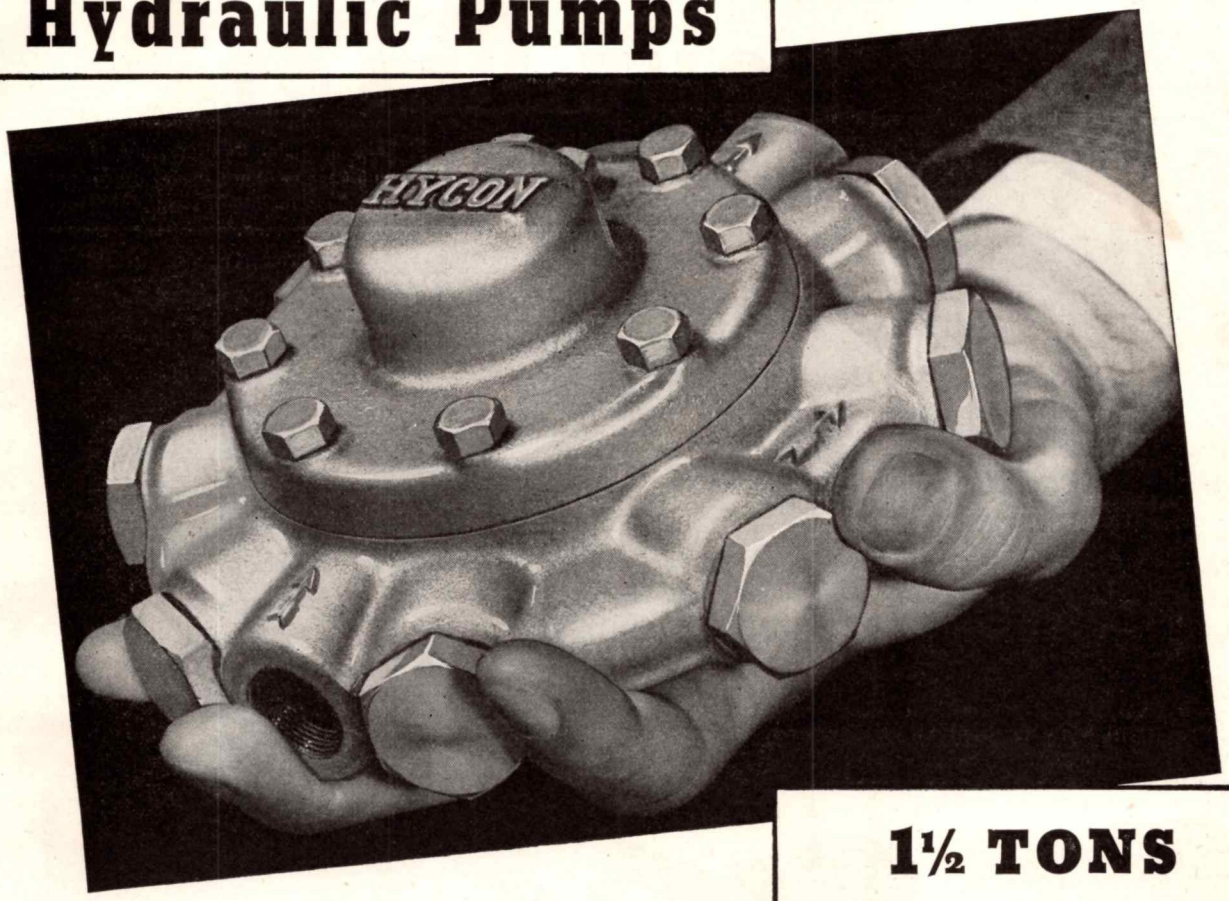

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L	1.05	3000	3 H. P.

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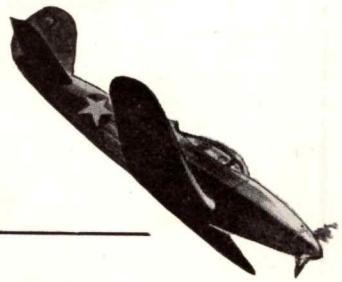

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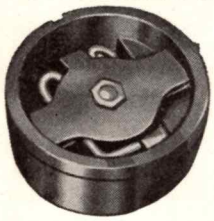
★★★ KLIXON  PROTECTORS

Motor limits don't mean a thing to a pilot with a Zero on his tail. He gives his plane the works. He's fighting for his life. Nothing else matters. So what happens?

One thing, the D. C. motors that operate the driving flaps, fuel pumps and other parts of the plane might be overloaded. And when they are overloaded too much, those motors burn out, *unless* those motors have a "Stout heart".

By a "Stout heart" we mean a built-in Klixon Protector which automatically recycles the motor . . . turns the motor off when it is too hot and turns it on again when it is cooled to a safe operating temperature . . . thereby preventing a burn-out and keeping the motor in action until our pilot gets his Zero and reaches his base in safety.

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when other motors quit

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Wood

Plywood & Plastics—I—Resin-Bonded & Impregnated Wood Veneer Heralds a Return to Wood Construction—W. Nichols, Flight, *Vol. XLIV, No. 1804, July 22, 1943.*

It is dangerous and unsound to herald any single material as the only material for as complex a machine as an airplane. The quantities of units to be built, their size, service intended, place of operation and a number of other considerations should influence the selection of the materials to be used. For that matter each part of the airplane functionally and structurally dictates such a selection. Of course, the latter consideration is not entirely practical since it is not reasonable to expect one company to have the expert personnel and machinery to apply to widely diversified materials. Hence, it must be anticipated that there will be manufacturers who will prefer to specialize in a given material depending on the type and nature of aircraft being produced by them. Since, however, wood has an excellent possibility, it is believed that the series of Mr. Nichols' articles, of which this is the first one, will prove of general interest.

Engines

The Mercedes—Benz, D. B. 601A, The Aeroplane, *July 16, 1943.*

This report, supplied by the *Ministry of Aircraft Production,* describes the construction of the Mercedes—Benz DB 601A engine, the method of installation in the Me109, Me110 or He111p and the associated cooling, air intake and exhaust systems. Reports of this nature have appeared from time to time in various British technical publications but ordinarily they are quite abbreviated. The present report is very complete, and, according to the editor's preface, is "almost exactly as received." The report covers the general description, mounting, crankcase, main bearing, crankshaft, connecting rod assembly, pistons, cylinder blocks, supercharger, supercharger variable-speed hydraulic drive, throttle and boost control, induction system, fuel pressure pump, fuel injection system, de-aerator, injection pump, injection pump control, injection nozzle, engine lubrication system, cooling system, propeller governor unit, and principal data and dimensions.

Straighteners

Cascade Theory and the Design of Fan Straighteners, A. R. Collar, B.A., B.Sc. British Ministry of Aircraft Production Reports and Memoranda *No. 1885.*

Straighteners commonly consist of a bank of fixed radial vanes placed behind a fan. In the present report the possibility is examined of designing a set of straighteners which will render the flow axial irrespective of the sense or, within reasonable limits, of the magnitude of a slipstream rotation, and an examination is made of the experimental and theoretical evidence available for the design.

It is concluded that, provided stalling does not occur, a ring of straighteners of symmetrical aerofoil section, set radially with their chords parallel to the axis of the fan, and having a gap-chord ratio of approximately unity (so that the local chord is proportional to the radius), will remove rotation from the slipstream of a fan to a degree sufficient for most practical purposes.

Milling

Spar Milling. A New Machine Incorporating Hydraulic Copying Mechanical and Automatic Variable Feeds. Production Data. Aircraft Production, *Vol. V, N.55, May 1943.*

A feature of the new spar milling machine recently introduced by A. C. Wickman, Ltd. of Coventry, is the provision of hydraulic copying mechanism to control vertical cutter movement when milling spars with profiled sections. It is a heavy-duty machine with a 50-hp motor for driving the cutter spindle, with overload capacity for heavy sinking operations, and to ensure even torque and smooth running under all cutting conditions, the spindle is fitted with a heavy dynamically balanced flywheel.

In one instance the following performance is cited in the article: Spindle speed 1200 rpm, peripheral cutting speed 4400 fpm, horizontal feed rate 20.9 ipm, the cutter was sunk to depth at the rate of 2 ipm.

Armament

Bristol Gun Turrets, L. G. Frise, Chief Designer, Bristol Aeroplane Co., Ltd, The Aeroplane, *April 16, 1943.*

This is more of an historic review of the Bristol gun turrets than a technical presentation of the mechanical or military considerations which governed their design. The paucity of text is, however, recompensed by excellent illustrations which accompany the article. Note illustration of electrical interrupter which prevents a gunner from shooting his own airplane's structure.

Warfare

Night Pursuit (Chasse de Nuit, Flugwehr und Technik, *N.2, February 1943).*

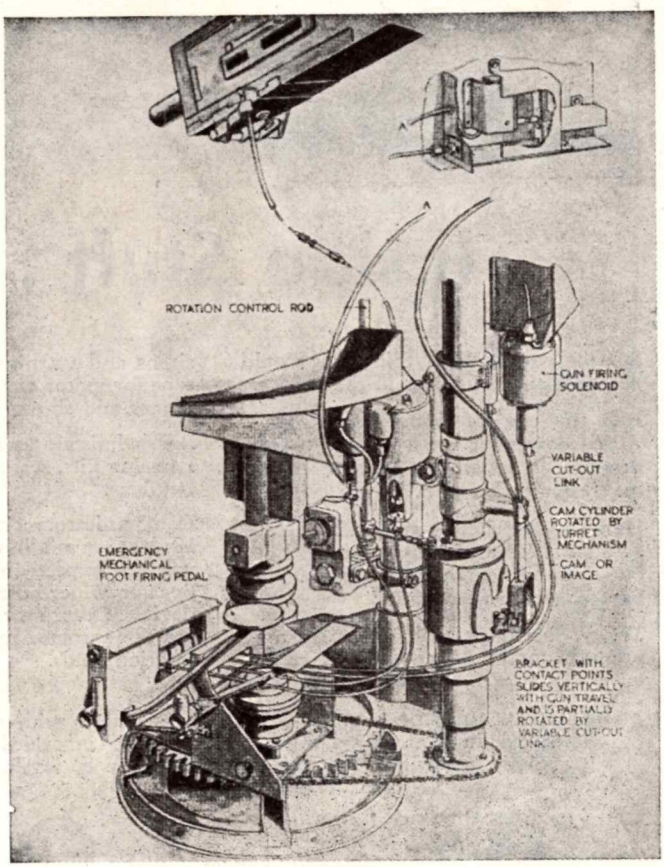
This article is a partial translation of a report which appeared in a German publication *"Luftwelt."* For reasons of military secrecy the article leaves a great deal unsaid about the technique of operation of night pursuit except that it alludes to the methods of radio detection and direction as indispensable to efficient operation. It is safe to assume that the method meant is the *Radar.* Whether the detection by *Radar* is combined with radio beam for direction to assure overtaking the enemy is not stated either. Night attack to many of us appears as a very effective method of bombing the enemy—how fast the methods of defense will be able to cope efficiently with the night intruders will be learned by most of us after the veil of military censorship can be lifted.

Drag

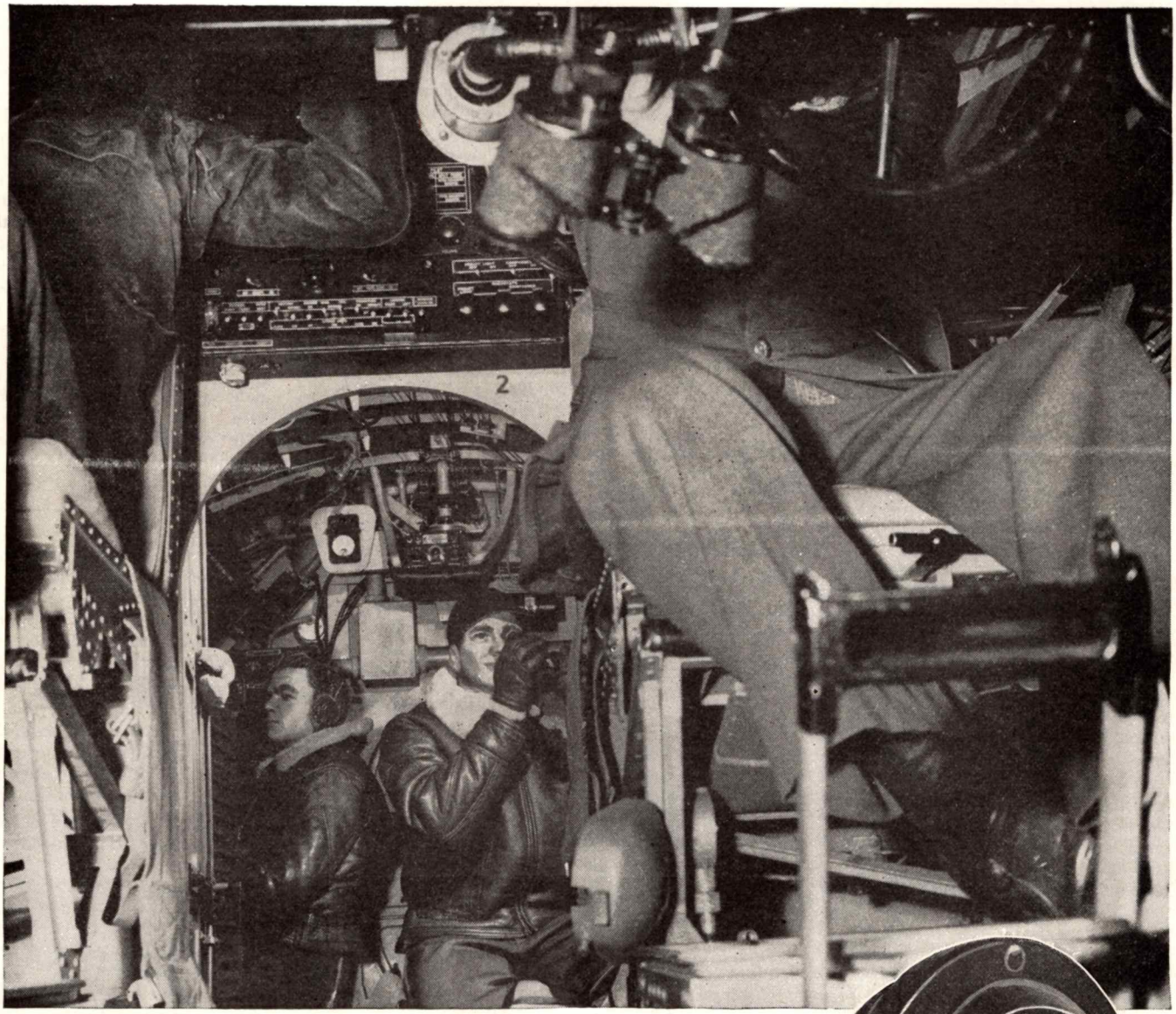
Drag of Circular Cylinders in Flight.—A. V. Stephens, M.A. British Ministry of Aircraft Production Reports & Memoranda *No. 1892, Oct., 1940.*

Much data has been collected on the drag of circular cylinders in wind tunnels. In all tests, the drag coefficient is found to maintain a steady value of approximately 1.2 up to a certain Reynolds number and then to fall

(*Continued on page* 443)



ELECTRICAL INTERRUPTER—A diagram of the gear which prevents a gunner from shooting his own airplane's structure. The arc of cut-out varies with the speed of rotation. From "The Aeroplane"



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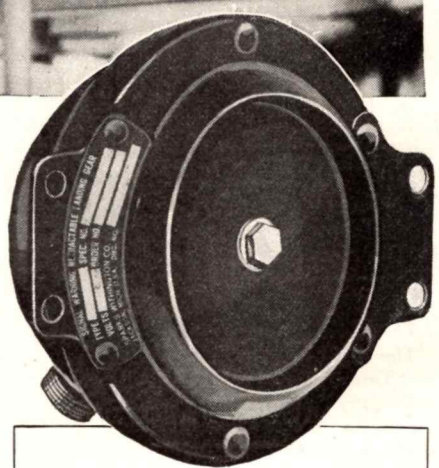

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(*Continued from page* 441)

progressively to a much lower value. The lower the turbulence and the smoother the cylinder, the higher does this Reynolds number become. It is now well established that no turbulence is to be found in the free atmosphere. The sharp fall in the drag coefficient, characteristic of circular cylinders, occurred at approximately the same Reynolds number in flight as had previously been found in low turbulence wind tunnels. Roughening the cylinder caused this fall to occur at a lower Reynolds number, but the lowest drag coefficient then reached was greater than that of the smooth cylinder.

Powerplant

The Production of "Power Eggs".—The Alvis System of Building Installations for Merlin Engines, M.T., Aircraft Production, *Vol. V, No. 51, January 1943.*

The need for standardization of aircraft powerplant installations has been recognized for some time. It must be admitted that Germany stole the march and was followed later by Britain. In this country there have been many recommendations to the effect that standard power units be designed which could be used interchangeably on various aircraft; but nothing is known to have been done to achieve this end. The present article describes the Wellington powerplant unit being built by Alvis, Ltd. The type of principal jigging and process of assembly, although sufficient to assure the degree of required accuracy, would not be considered in this country as representative of the best production assembly methods.

Wind Tunnel

The Use of a Freely Rotating Windmill to Improve the Flow in a Wind Tunnel.—A. R. Collar, B.A., B.Sc., British Ministry of Aircraft Production Reports & Memoranda, *No. 1866, Nov., 1938.*

A method is described for the improvement of the velocity distribution in the working section of a tunnel by placing upstream of the contraction a freely rotating windmill. The principles of design for such a windmill are given and its action is to transfer total head from high speed regions to low speed regions as required; the total head distribution is thereby equalized, not only in the empty tunnel, but also when shadows due to large models occur. The forces on a windmill due to changes of axial wind speed in the tunnel are discussed. Some experimental results obtained from model tunnels show that a windmill improves velocity distribution and at the same time gives increased steadiness.

Transport

Air Transports. Some Speculations on Future Designs for Civil and Military Purposes. The Importance of Loading and Stowage Facilities. C. A. H. Pollitt and J. H. Laver. Flight, *Vol. XLIII, N.1790, April 1943.*

The authors make a very creditable presentation of various possible cargo designs. Although the accompanying data giving weight and performance may be questioned, the approach to the problem is correct and therein lies the value of the article.

There have been altogether too many airplanes designed because they were conceived as good airplanes rather than as good passenger or cargo carriers. War with all its unfortunate consequences does force everyone to think for efficiency and economy and this thinking reflects itself in engineering designs.

The editors of *Flight*, despite their editorial caution as expressed in their note did well to publish the article.

Structures

Compression Tests on Curved Plates of Thin Sheet Duralumin.—H. L. Cox, M.A., and W. J. Clenshaw, B.Sc., A. Inst. P., of the Engineering Department, N.P.L., British Ministry of Aircraft Production, Reports and Memoranda *No. 1894, November 1941.*

Curved plates subjected to compression parallel to the axis of curvature deform in a similar manner to flat plates. Below the buckling load the plate behaves as a solid test piece, the compressive stress being uniform over the whole plate. After buckling the central part of the plate is stressed less heavily than the edges (which are constrained to remain straight) and, since the strain is proportional to the stress in the edges, the stiffness (rate of increase of load/rate of increase of strain) of the plate is reduced. In contrast to flat plates, buckling of curved plates may result not only in a reduction of stiffness but also in an actual reduction of load. No theoretical analysis of the buckling and behavior after buckling of curved plates with clamped edges is available; but on the basis of the experimental results, empirical formulas for the buckling stress and for the reduction of stiffness after buckling have been developed.

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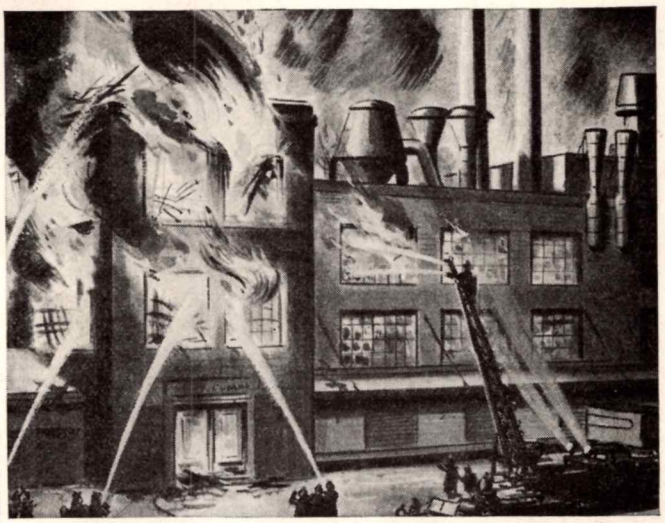

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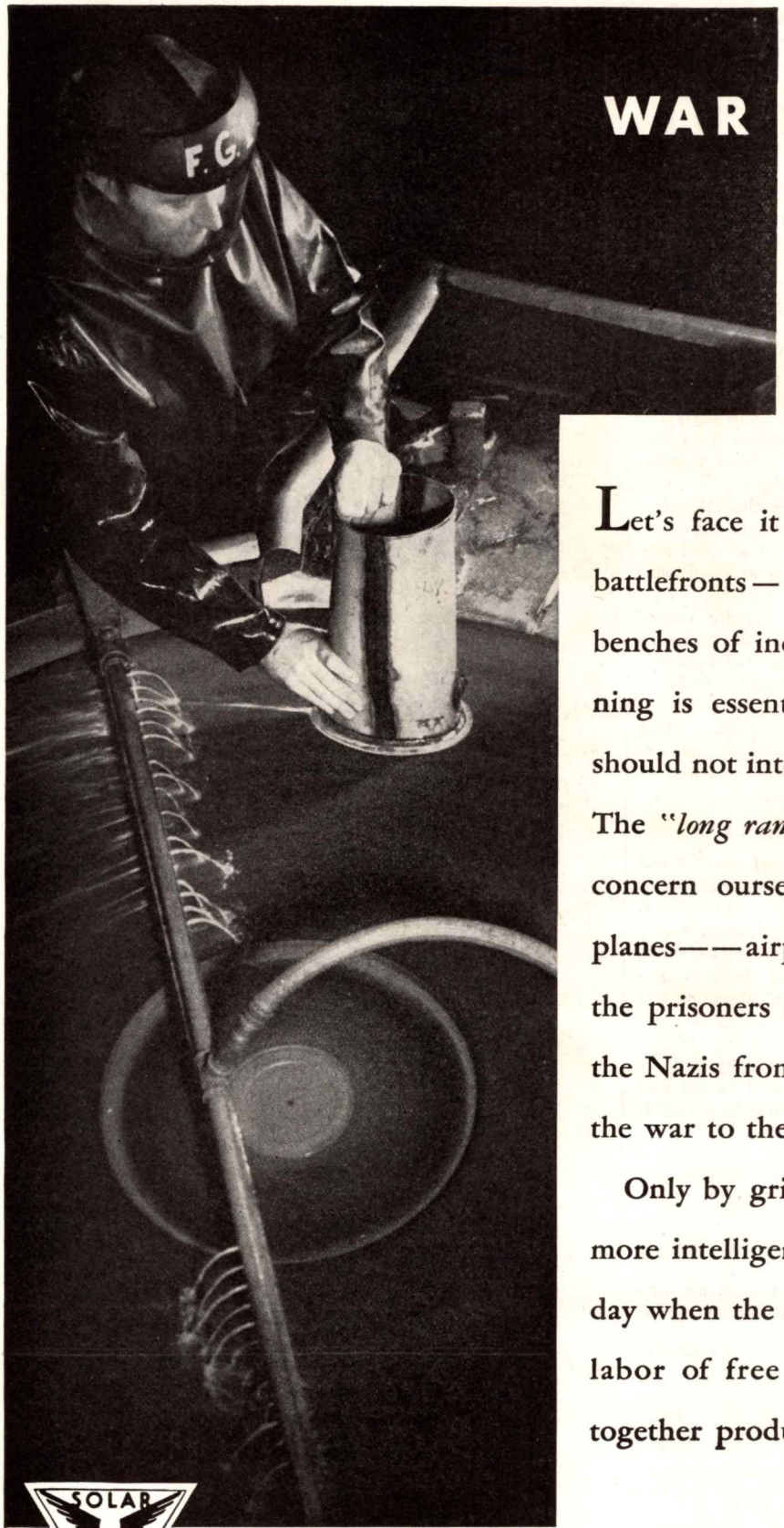
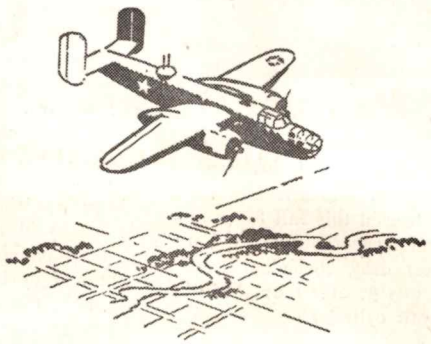


WAR IS A GRIND!



Let's face it squarely! War is hell on the battlefronts——a terrific grind at the work benches of industry. While *long range* planning is essential to winning the peace, it should not interfere with speeding the peace. The "*long range*" with which we must first concern ourselves is the range of our airplanes——airplanes which have yet to free the prisoners of Bataan...have yet to blast the Nazis from the war...have yet to bring the war to the very islands of Japan.

Only by grinding faster, more accurately, more intelligently *today*, can we hasten the day when the machinery of industry and the labor of free Americans can again work together producing peacetime products.

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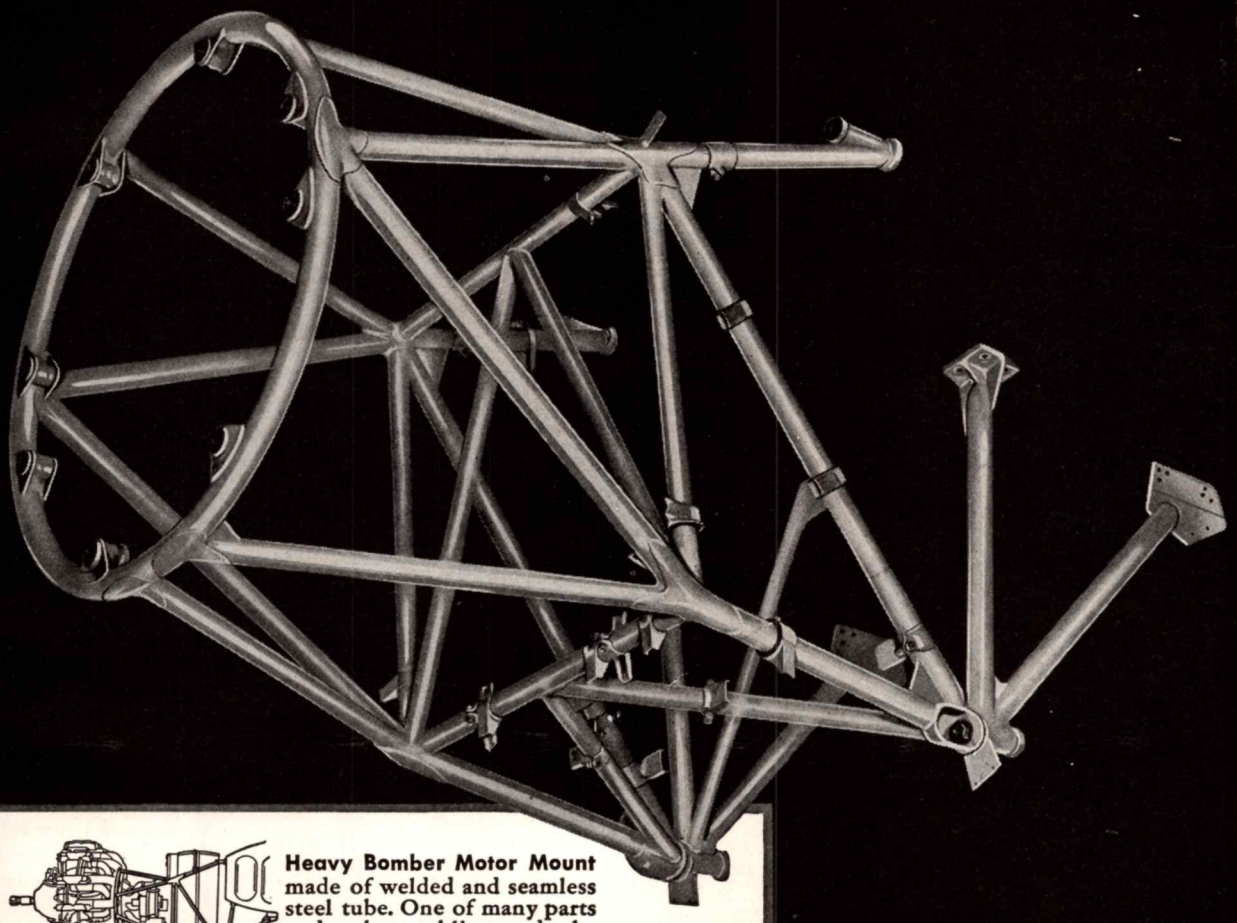

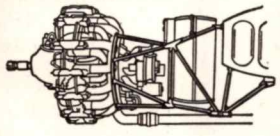

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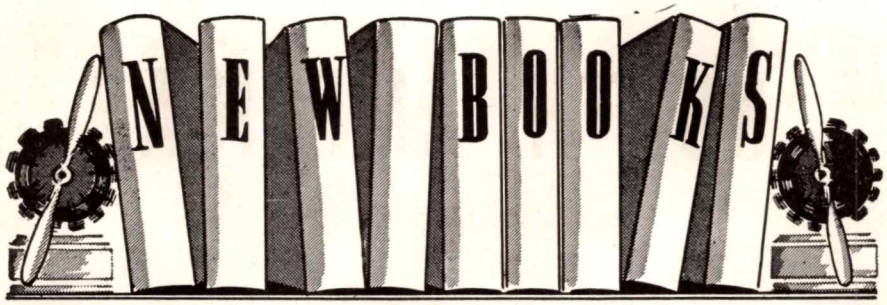

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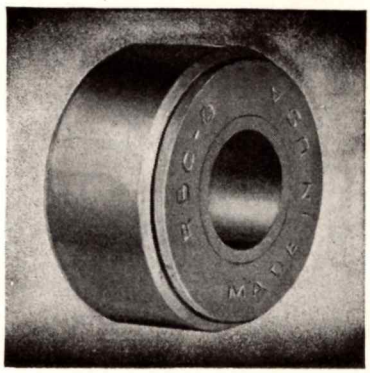

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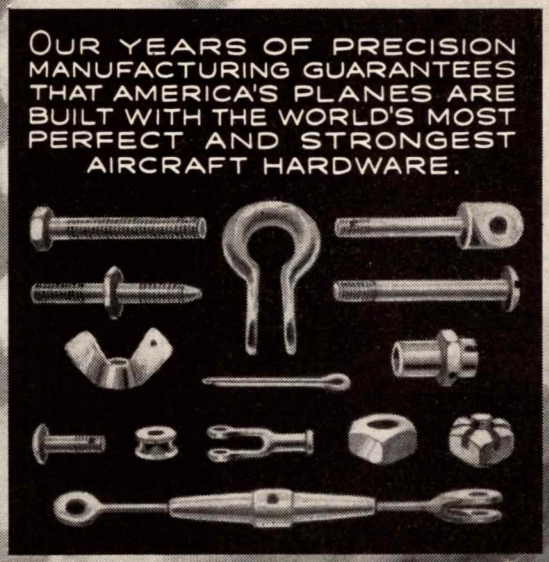

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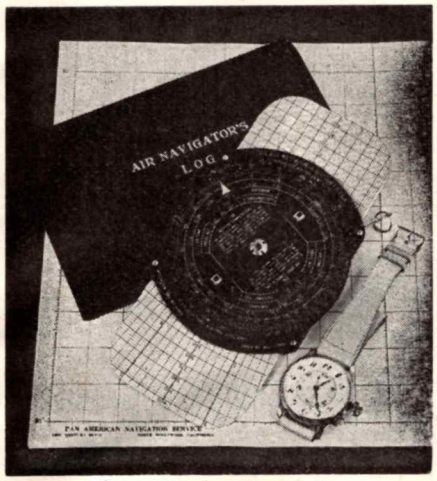

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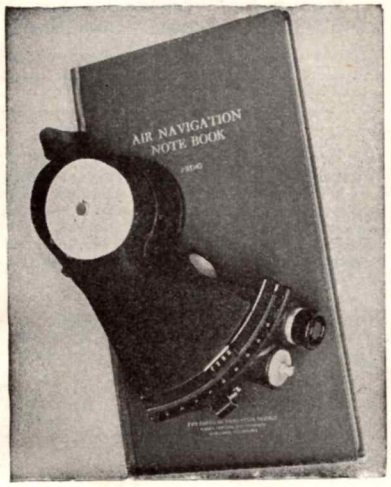

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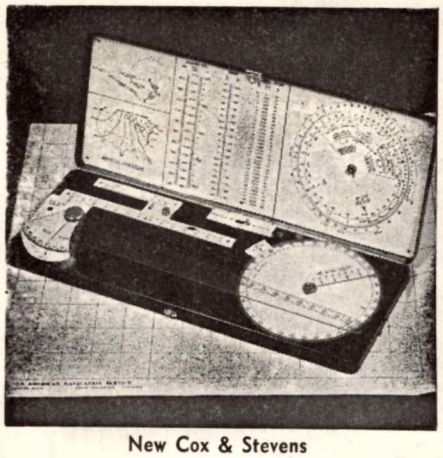

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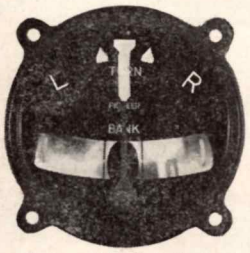

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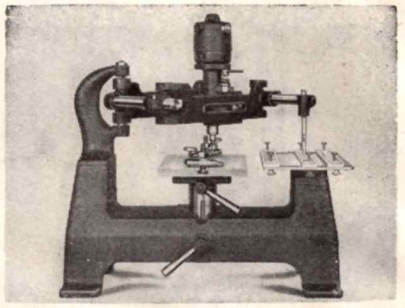

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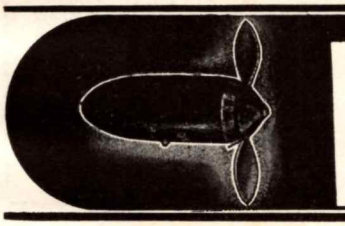

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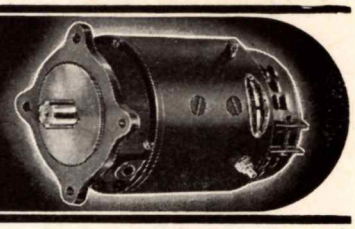

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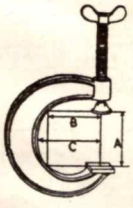

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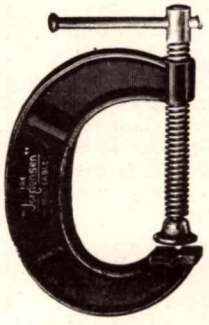

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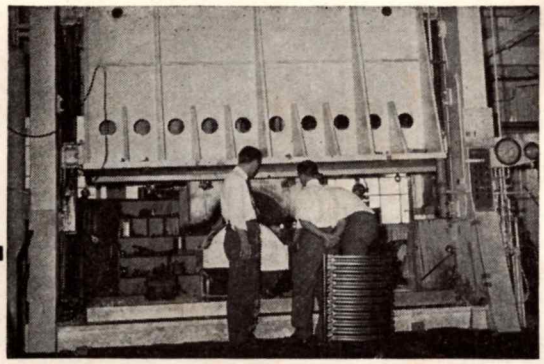

7 TON CERROBEND DIE

HEAVY STEEL STAMPINGS FOR FIRST ASSEMBLIES IN 8 DAYS

Illustration shows die in press and sample stamping drawn in die. The die is simply cast from a standard size plaster pattern. The punch is cast directly from the die. By using Cerrobend, shrinkage, finish, machining, spotting, etc., are entirely eliminated. All casting of metal is done by pumping metal through a hose as easily as pouring a plaster cast. The die shown, and many other dies by the tons, now being produced by CASTALOY, are proving that production of first assemblies and the answers for production tooling can be had more expediently than ever before.

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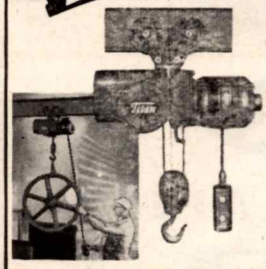

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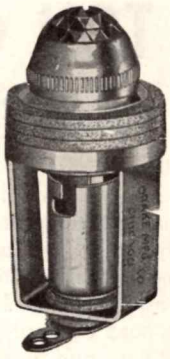

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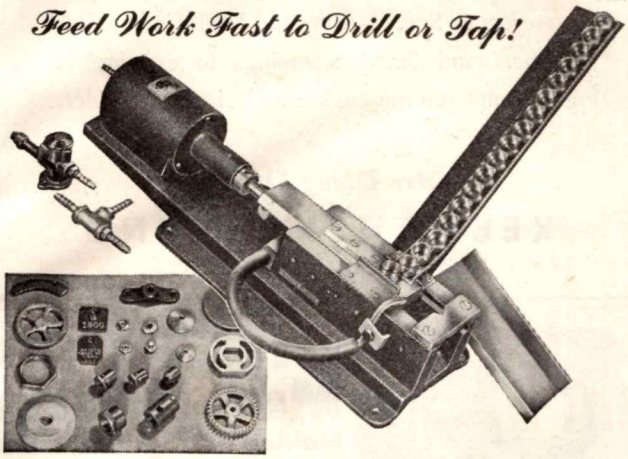

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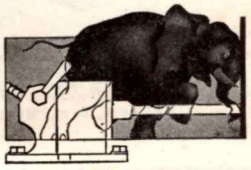

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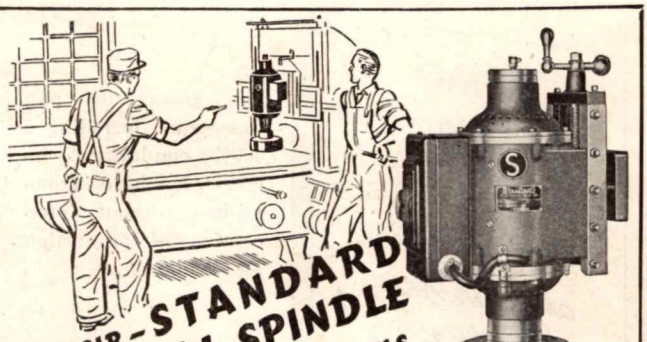

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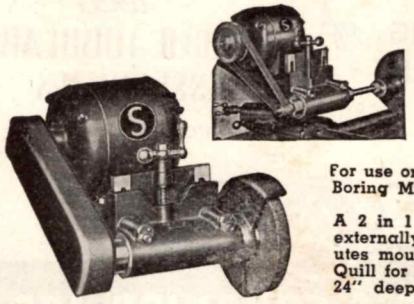

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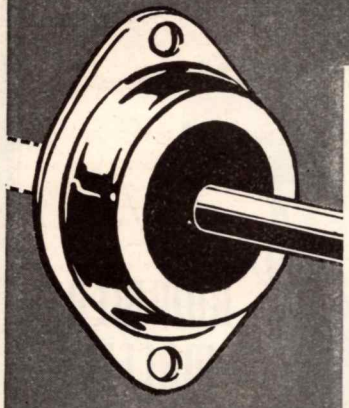

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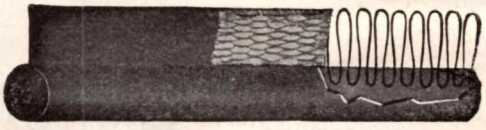

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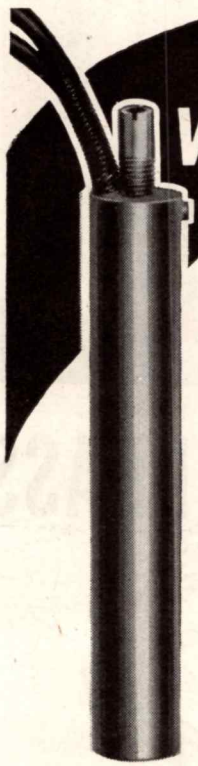

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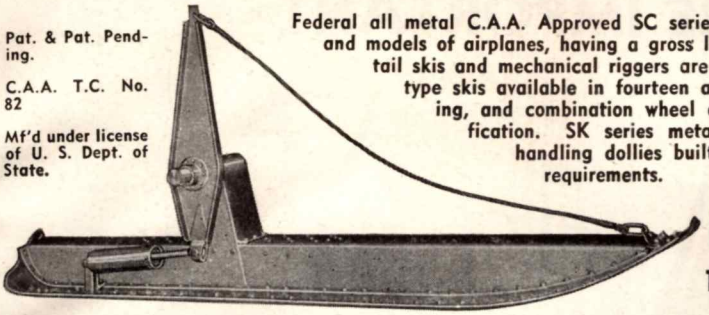

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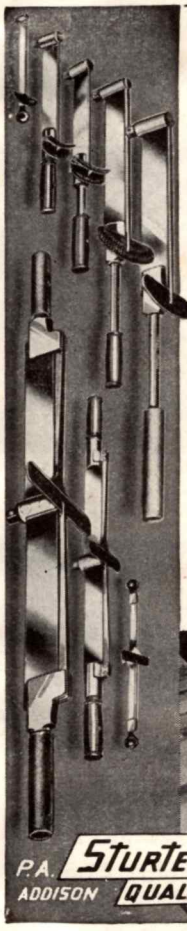

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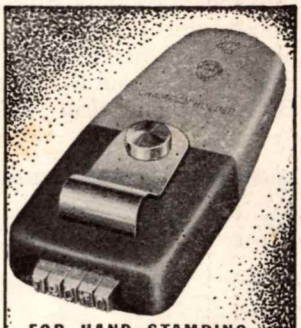

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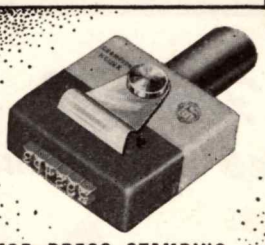

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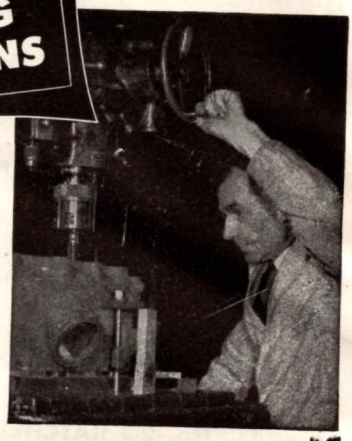

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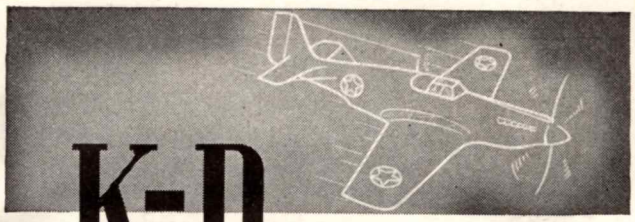

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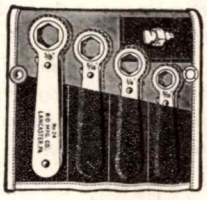

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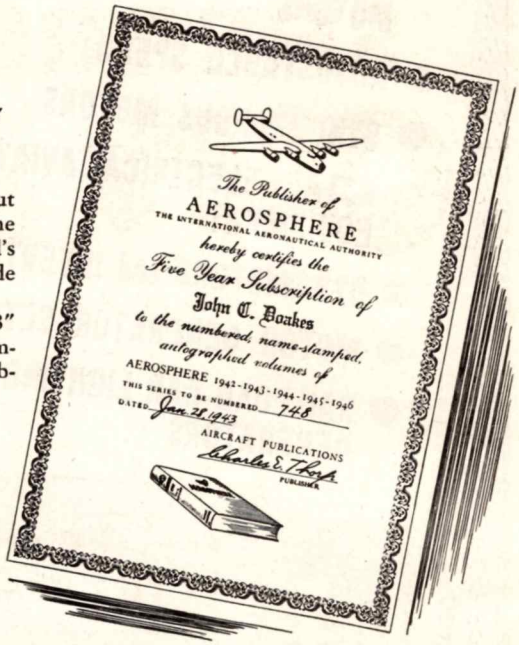

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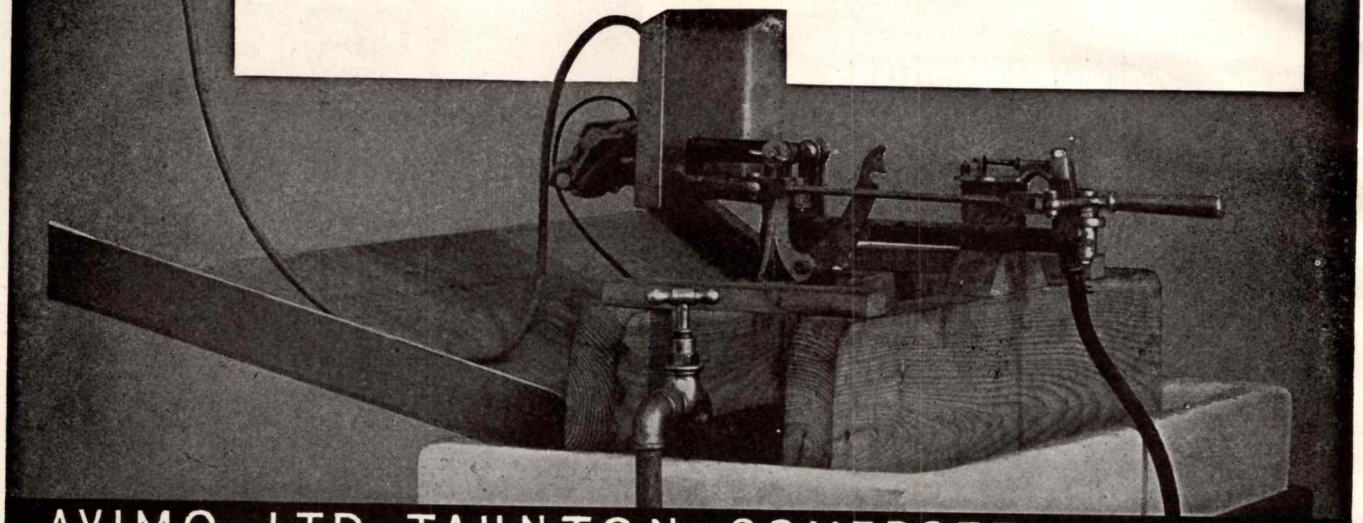

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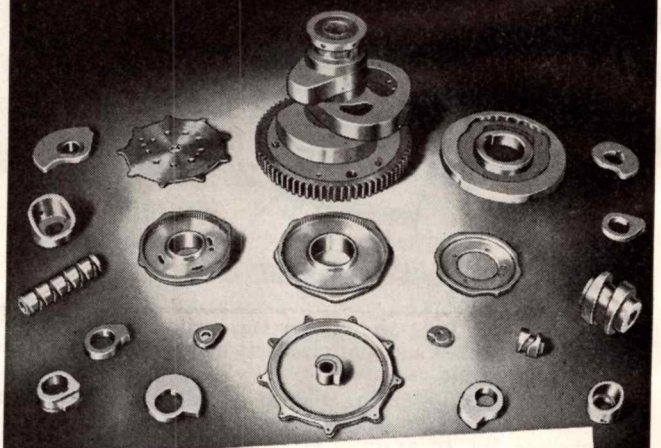

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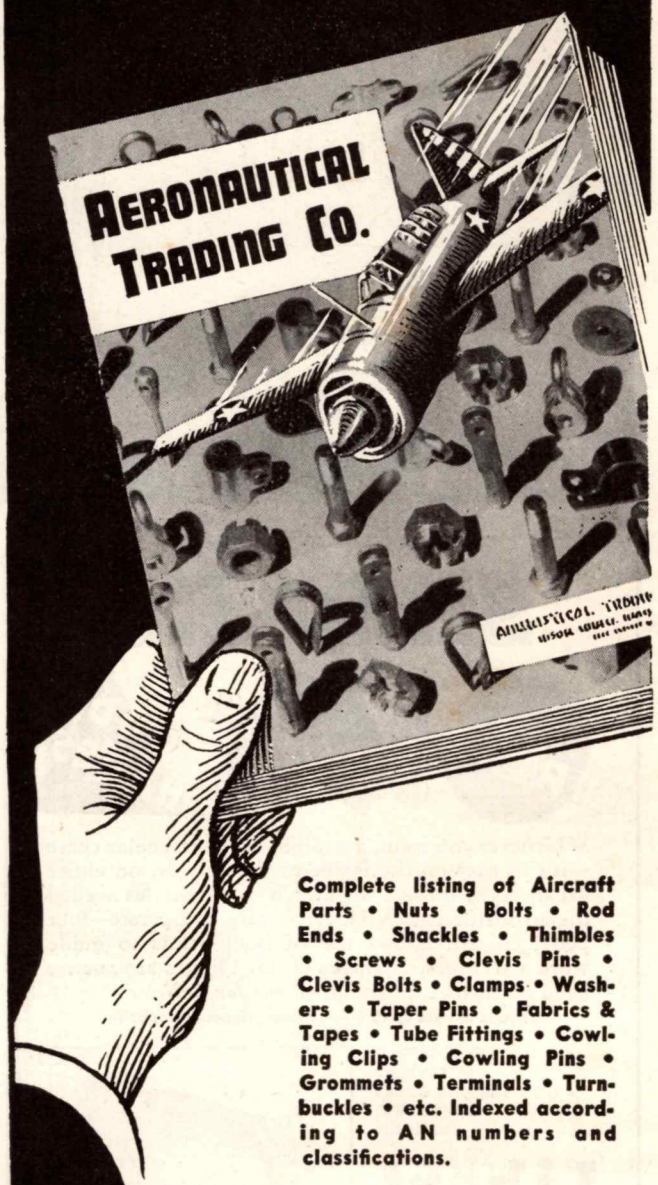

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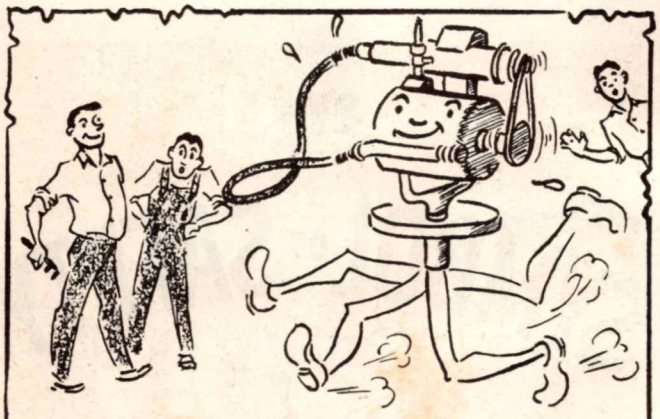

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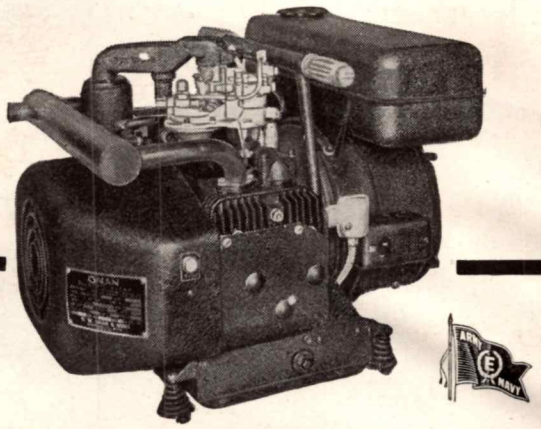

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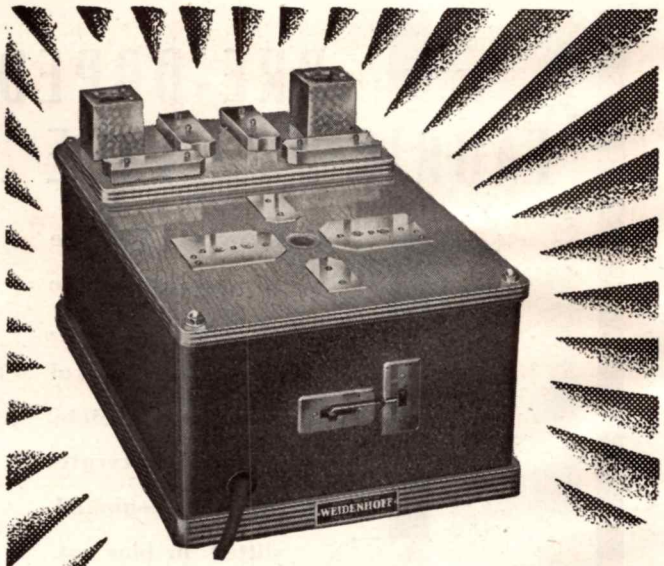

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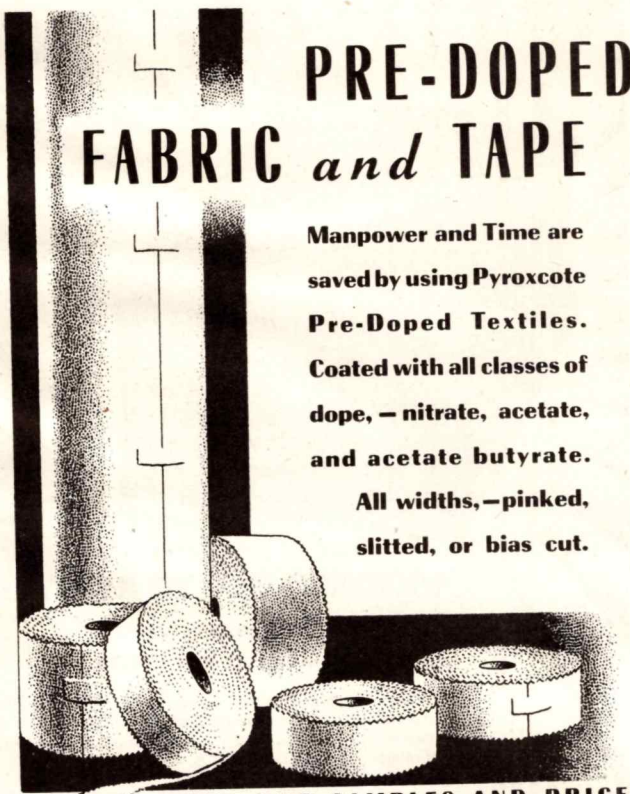

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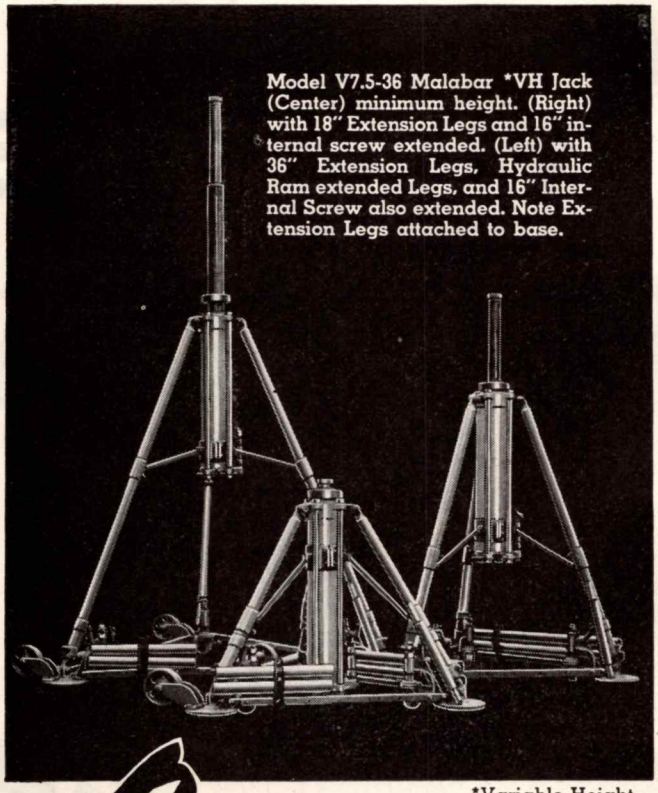

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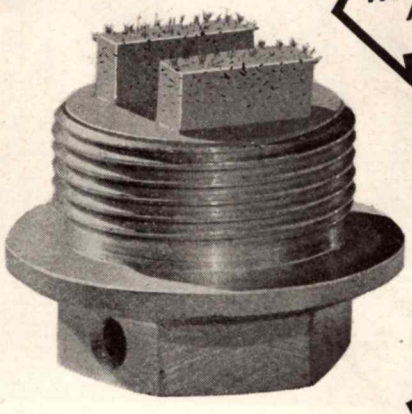

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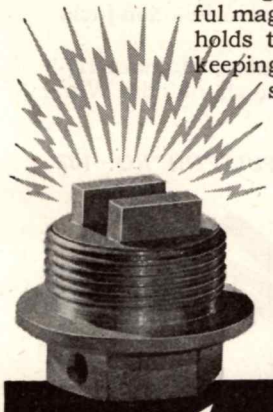

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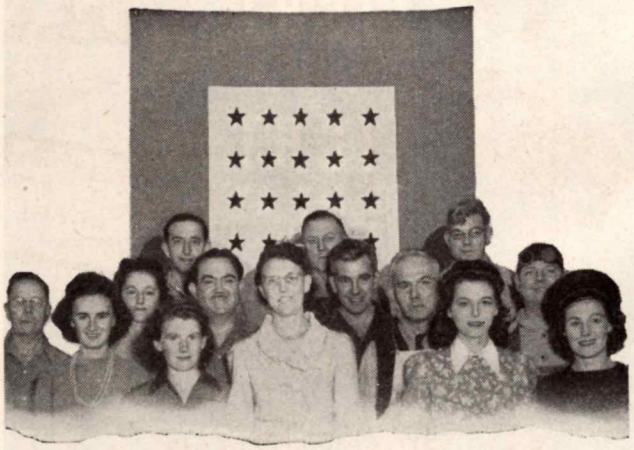

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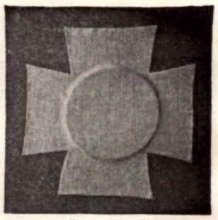
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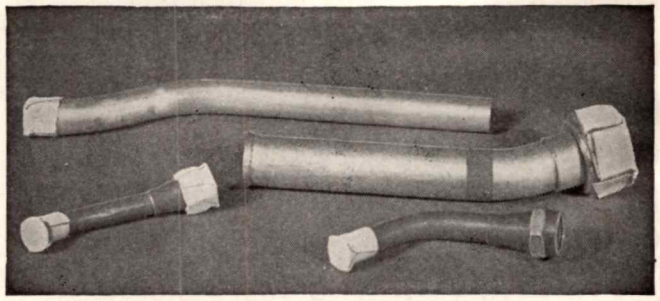

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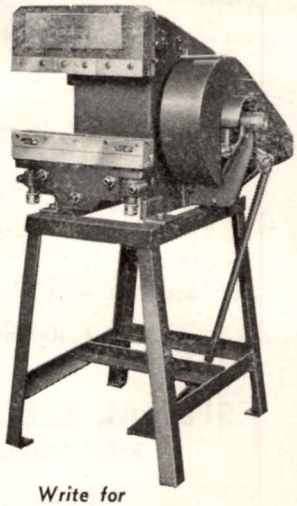

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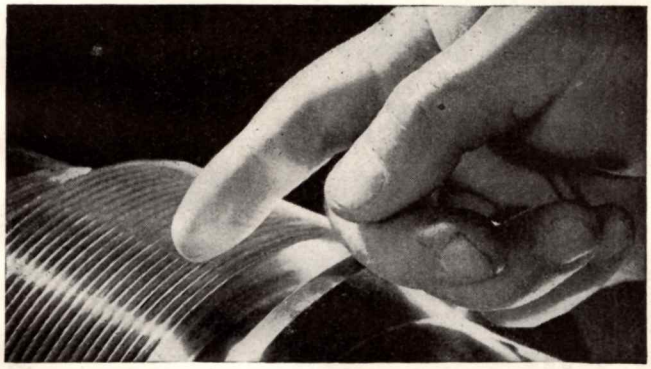

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FOR METAL CLEANING AND CONDITIONING AGAINST CORROSION

SOLVENTOL

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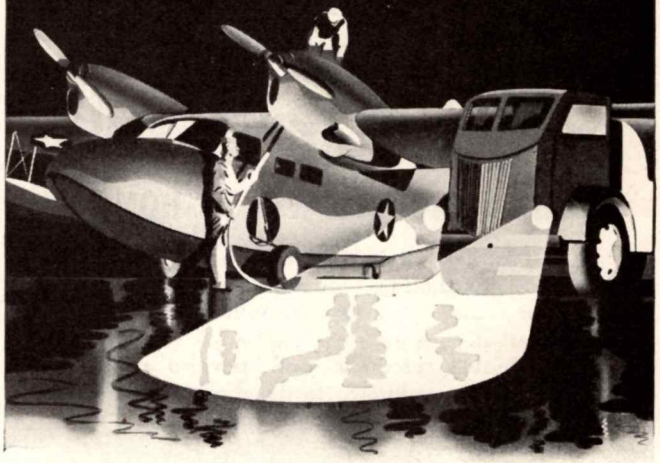
TO DRIVE BY
LIGHT
TO FLY BY



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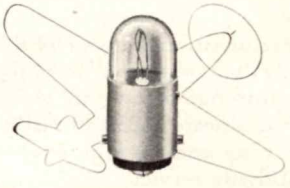

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TUNG-SOL LAMP WORKS INC., NEWARK, N. J., Sales Offices: ATLANTA, CHICAGO, DALLAS, DENVER, DETROIT, LOS ANGELES, NEW YORK, PHILADELPHIA.
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By This Simple, Cold Immersion Method

Because cleaning of aircraft pistons is considered a process apart from other aircraft overhaul operations, TURCO CARBRAX was formulated to fill this very special need. Its use presents the fastest, as well as the most thorough piston cleaning method yet devised.

TURCO CARBRAX simplifies the decarbonizing of pistons because it involves no more than simple cold immersion in a tank.

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Send TURCO CARBRAX Aircraft Engine Overhaul Booklet.

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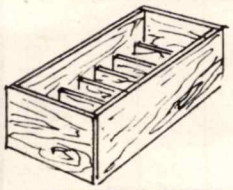

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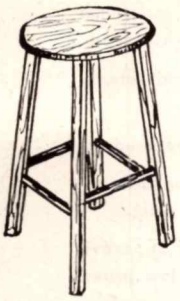

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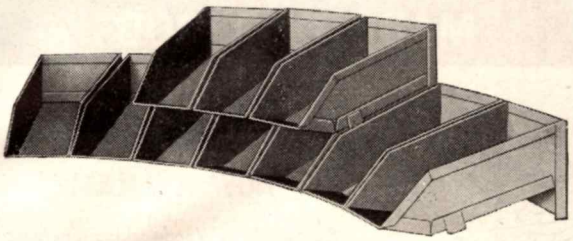
for assembling small parts



Floors slope to feed parts to front—end reaching and fumbling.

Bins taper toward front to form convenient semi-circle—keep all bins within easy reach.

Nesting, locking construction for rigid set-ups, easily changed when necessary.

All-welded construction. Rolled, smooth edges.

Two sizes—tapered or straight sides.

Hoppers available for steady work.

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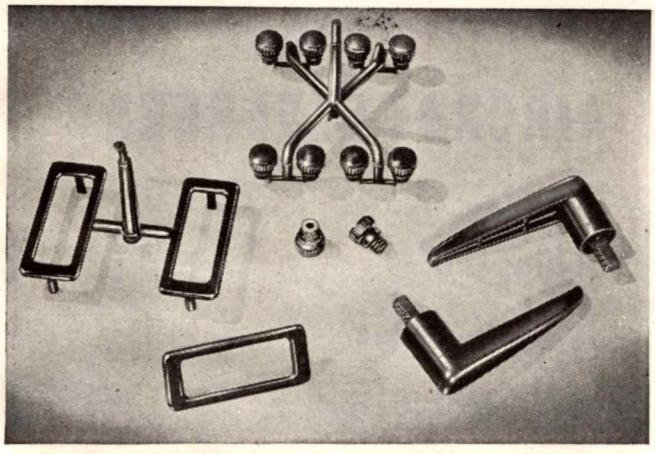

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Plastic is adaptable for manufacturing myriads of parts formerly made out of metal and wood. Usually plastic not only results in better looking parts, but also proves more economical to use. Door handles, knobs, flashlight cases, plumbing fixtures—these are just a few of thousands of items now being made with plastic. No matter how difficult your problem may seem, there is a good chance it can be solved with plastic. Why not consult us?

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with 90° Park Head

with 45° Park Head

with Straight Spindle

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STOW
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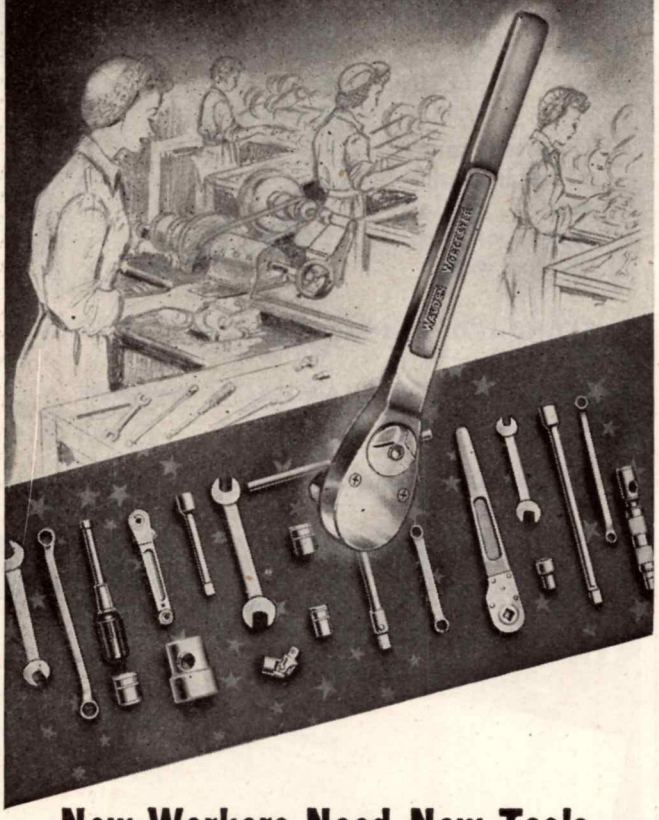

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Modern in design — strong-light — durable. Walden-Worcester in its long years of experience has always been a leader in making hard jobs easier by engineering its tools on the drafting board and testing them on the workbench. Don't buy heavy, clumsy tools when Walden - Worcester Tools are available.

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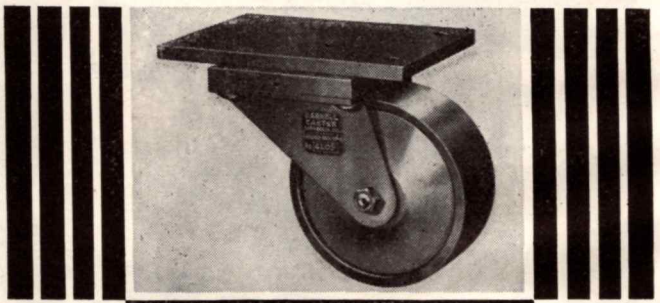

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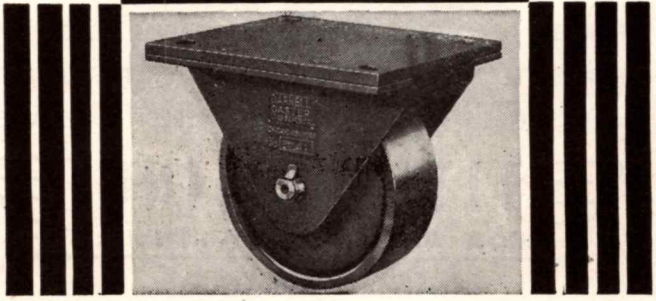


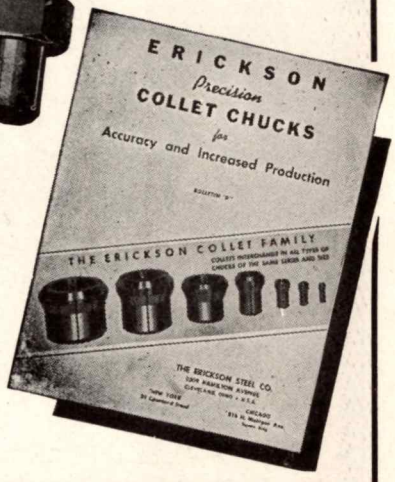
★ ERICKSON *Precision* COLLET CHUCKS

FOR EVERY TYPE OF PRODUCTION WORK

The Erickson Collet collapses at least 1/32" and maintains gripping power and accuracy.

Two new models have been added to the well-known line of Erickson Chucks. These are "01" of greater accuracy and precision for general work and the "02," especially designed for Turret Lathes, Automatics and Screw Machines.

These three lines are available in a complete range of sizes and shanks to adapt them for all types of equipment. The new, complete, improved lines are the result of constant research and improvement by Erickson Engineers collaborating with prominent users throughout industry.



8-POINT COLLET GRIP

The Erickson Collet—open slotted at both ends—grips the tool shank (at 8 points instead of 3) permitting heavier feeds without vibration or loosening. Collet is capable of collapsing as much as 1/32" while maintaining its grip and accuracy.

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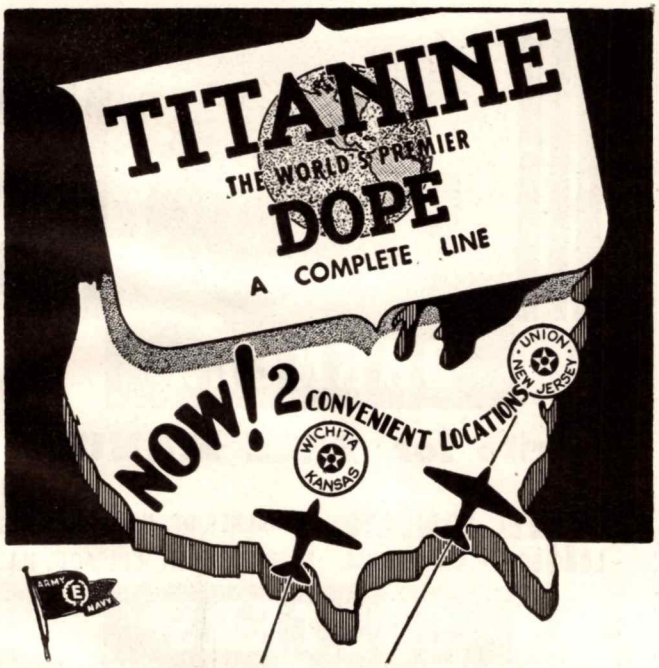

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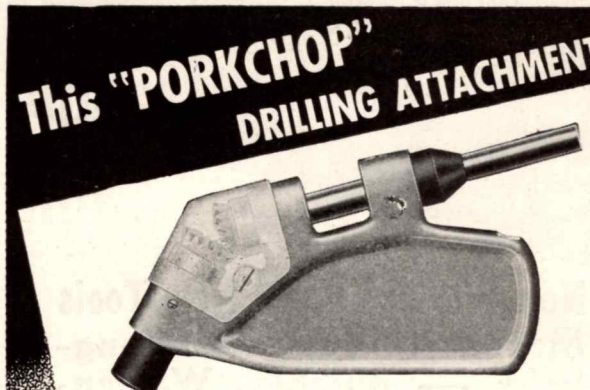

...makes awkward drilling easy

Here's a real "expediter" for aircraft construction. The handy design of the Terry Attachment No. 70, with 45° angle of the drill shaft, enables the operator to speed up drilling in difficult spots. Operation of this popular Terry Tool is smooth, quiet. Positive, comfortable grip; fully guarded. Heavy-duty body is made of bearing bronze, with renewable bronze spindle bearing. Gears are heat treated alloy steel, accurately machined. All parts are standardized, making replacements easy. New catalog on Terry Tools on request. In writing, please use company letterhead and indicate your title.

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. . . America will understand what pioneering means—doing great things without inexhaustible sources of equipment and material. When this war is history, America will pioneer again—in new places, with new products that will make a better world.

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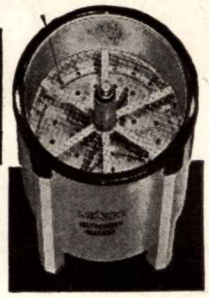
Filings, burrs, etc., from brass or copper screw machine parts salvaged in sediment trap will soon pay for this machine.



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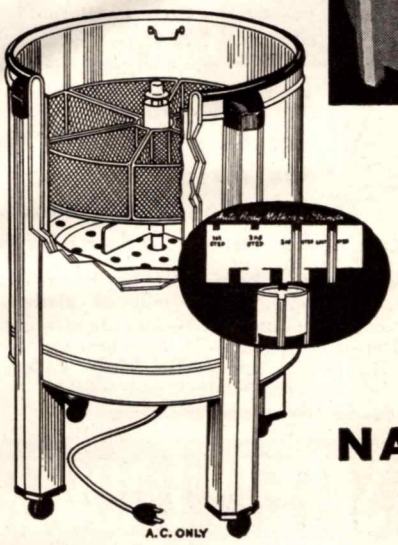

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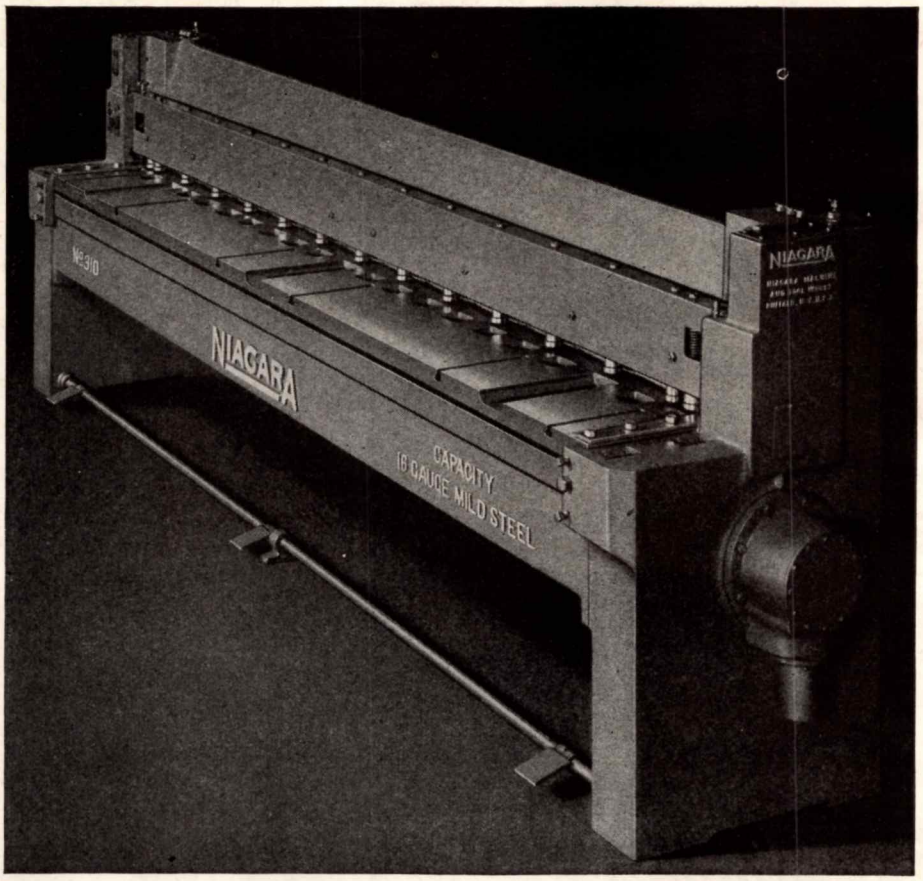

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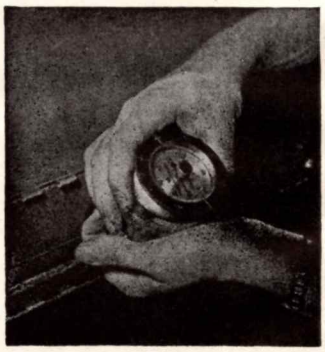

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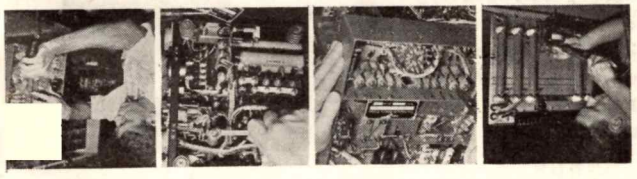

The Ward Leonard, Vitreous Enamel, Wire Wound Resistors, shown, are used on maintenance and operation equipment at the Miami Clipper base of Pan American World Airways.

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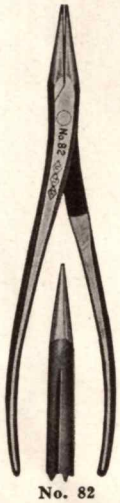

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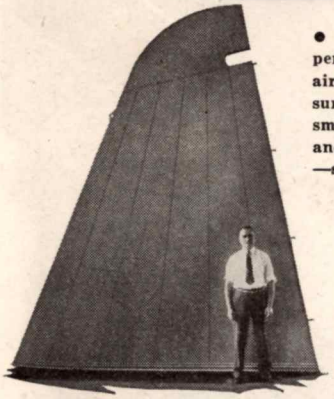

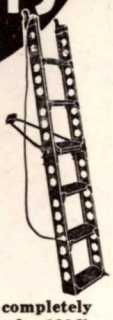

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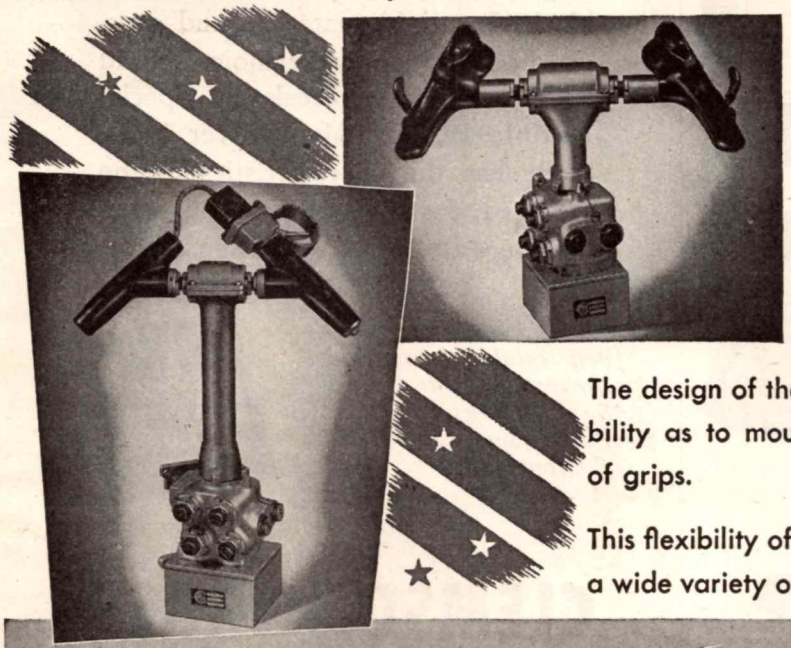
Clarke HYDRAULIC GUN TURRET CONTROL VALVES

AERO-HYDRAULICS, INC.



- ***Smoothness of control***
- ***Ease of adjustment***
- ***A definite "feel"***

These qualities as found in the Clarke Aero-Hydraulic Gun Turret Control Valve account for the effective fire power obtained in turrets using the Clarke Valve.

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3 flute		X			
4 flute	(x)	(x)	(x)	(x)	(x)
1/4-28 2 flute	X	X	X	X	
3 flute					
4 flute	(x)	(x)	(x)	(x)	X
5/16-18 2 flute		X			
3 flute					
4 flute	(x)	(x)	(x)	(x)	(x)
5/16-24 2 flute					
3 flute					
4 flute	X	X	(x)		
3/8-16 3 flute					
4 flute	(x)	(x)	(x)		
3/8-24 3 flute					
4 flute	X	X	(x)		
7/16-14 3 flute					
4 flute	X	(x)	(x)		
7/16-20 3 flute					
4 flute	X	X	(x)	(x)	
1/2-13 3 flute					
4 flute	(x)	(x)	(x)	(x)	(x)
1/2-20 3 flute				X	
4 flute	(x)	(x)	(x)	(x)	(x)

SIZE	PG 01	PG 1	PG 2	Cmml Grnd	Cut Thr
9/16-12 4 flute	X	(x)	(x)	(x)	
9/16-18 4 flute	X	X	X	X	X
5/8 -11 4 flute	X	(x)	(x)	(x)	(x)
5/8 -18 4 flute	X	(x)	(x)	(x)	(x)
11/16-11 4 flute					
11/16-16 4 flute					
3/4					
				X	X
	X	X	X	X	X
1 3/8-6 4 flute					
1 3/8-12 4 flute					
1 1/2-6 4 flute				X	X
1 1/2-12 4 flute					

Ask to have your name put on our mailing list to receive these lists of HY-PRO Taps for Shipment from Stock

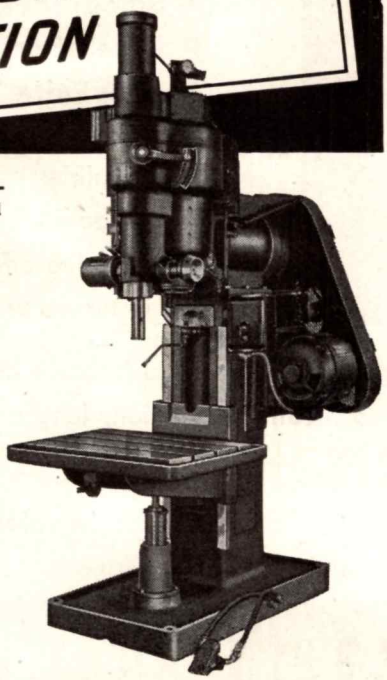
STANDARD HIGH SPEED STEEL HAND TAPS, SPIRAL POINT

SIZE	PG 01	PG 1	PG 2	Cmml Grnd	Cut Thr
1/4-20 2 flute	X	(x)	(x)	(x)	
1/4-28 2 flute	(x)	X	X	(x)	
5/16-18 2 flute	(x)	(x)	X	X	X
5/16-24 2 flute	X	X	(x)	(x)	X
3/8-16 3 flute	X	(x)	(x)	(x)	X
3/8-24 3 flute	X	X	X	X	X
7/16-14 3 flute	X	(x)	(x)	(x)	
7/16-20 3 flute	X	(x)	(x)	(x)	X
1/2-13 3 flute	X	X	X	X	
1/2-20 3 flute	X	(x)	(x)	(x)	

X - Less than 100 pcs. (X) - More than 100 pcs.

HY-PRO TOOL CO.
New Bedford, Mass., U.S.A.
BUY MORE BONDS-GET IN THE SCRAP

For CONTINUOUS HIGH DUTY PRODUCTION



KAUFMAN No. 10 A Hi-Duty single spindle Lead Screw Tapper, made in 3 HP and 1½ HP models, with ¾" N.C. and 1½" N.C. threads in alloy steel offers these features:

Fully enclosed . . . lead screw and nut operate constantly in oil bath . . . positively wear-proof clutches instantly engaged and controlled by air cylinder . . . quick traverse when not actually cutting threads . . . accurate depth control . . . control to protect tap overload, and further protected against jamming if work is placed in upside down . . . class 3 fits always assured and perfectly controllable. ***Complete information upon request.***

L. J. KAUFMAN MFG. CO.
MANITOWOC, WISCONSIN

The STAR line of Hack Saw Blades includes a blade for any type of metal sawing. For high-speed cutting, the "Moly" Type*—the original molybdenum alloy blade—is recommended. It can be recognized by its gold finish with the name STAR in black. For light materials and awk-ward sawing jobs your choice should be the STAR Unbreakable Special Flexible Blade. This all-over black blade has the characteristics of the all-hard. Its flexibility eliminates breakage and tooth strippage.

STAR has just issued a new catalogue covering the complete line of Hack Saw Blades, Frames, Power Saws, Band and Contour Saws.

CLEMSON BROS.
Incorporated
MIDDLETOWN • NEW YORK
**T. M. Reg.—Blades bearing the name "Moly" are made only by Clemson Bros., Inc. and affiliated companies.*
Makers of Hack Saws, Frames, Band Saws and Power Saws.

It's Santa's favorite charity!

WE'VE never asked Santa Claus what *his* favorite charity is, but we'd bet the old fellow would chuckle: "Why, *Christmas Seals,* of course!"

You see, these little Seals give the greatest gift of all—health, life itself. As long as Santa can remember, the American people have made this a part of their Christmas giving—in depression and prosperity, in peacetime and war.

This year our needs are doubly great—because a wartime rise in tuberculosis must be prevented. So, make sure that every letter and package carried by Santa is stamped with your Christmas gift to mankind—and please send in your contribution *today!*

BUY CHRISTMAS SEALS

Because of the importance of the above message, this space has been contributed by

AERO DIGEST

SAVE CRITICAL MATERIALS IMPROVE PRODUCT PERFORMANCE

Irvington's Extruded Plastic Tubings are steadily gaining wider acceptance by manufacturers of electrical and other types of equipment as a replacement for rubber or metal tubing. In addition to better serving their primary purpose, that of electrical insulation, in many cases these tubings have other advantages over the materials replaced.

As an instance – Irvington Tubings have better flexibility and resiliency than most rubbers at low temperatures – one type is transparent–still another has the high tensile strength of 3000 lbs. per sq. in.

All Irvington Plastic Tubings have excellent dielectric and tensile strengths, resistance to acids, alkalies, oils, moisture and many solvents – do not support combustion. Each one has specific qualities which make it an ideal insulation for particular conditions.

Here is a list of Irvington Plastic Tubings and a brief statement of their outstanding characteristics.

HYFLEX

A rubber-like tubing with high resistance to abrasion – good chemical stability – does not become brittle at –58 deg. F. Obtainable in six opaque colors.

IRV-O-LITE

Most widely used tubing – for wiring and lug insulation or as conduit. Two types, both available in six opaque colors – XTE-30 for all-around usage; XTE-130 for applications involving higher temperatures, greater dielectric and tensile strengths.

IVI-FLEX

Developed for use at extremely low temperatures; withstands a hammer blow at –70 deg. F., can be pinched at –80 deg. F. – especially flexible and elastic.

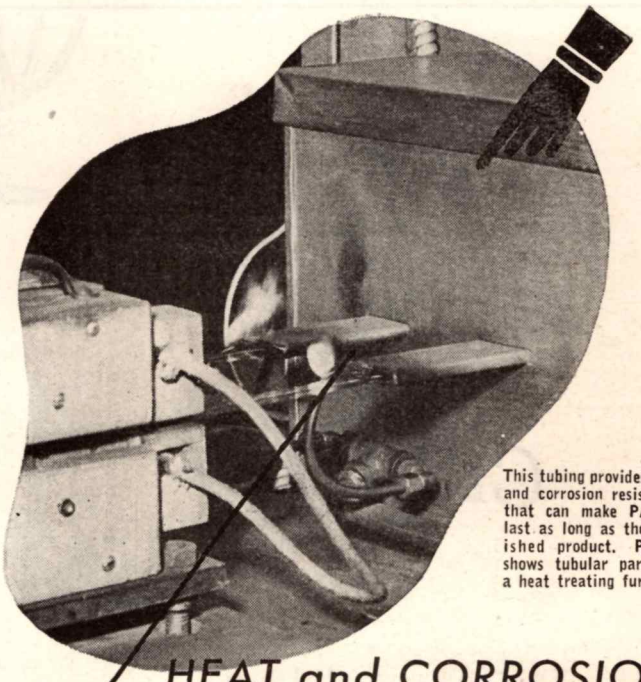
TRANSFLEX

Transparency permits quick tracing of circuits or location of wire breaks when used as conduit – unusual elongation permits stretching over splices, lugs and other projections – does not become brittle at –58 deg. F.

Let Irvington help solve your insulating tubing problem. For complete data and test samples write Dept. 16.

STANDARD OF THE WORLD
IRVINGTON INSULATION
TRADE MARK

Irvington
VARNISH & INSULATOR CO.
IRVINGTON NEW JERSEY, U. S. A.
PLANTS AT IRVINGTON, N. J. and HAMILTON, ONT. CAN.
Representatives in 20 Principal Cities



This tubing provides heat and corrosion resistance that can make **PARTS** last as long as the finished product. Photo shows tubular parts of a heat treating furnace.

HEAT and CORROSION PROBLEMS SOLVED

With This Stainless Tubing

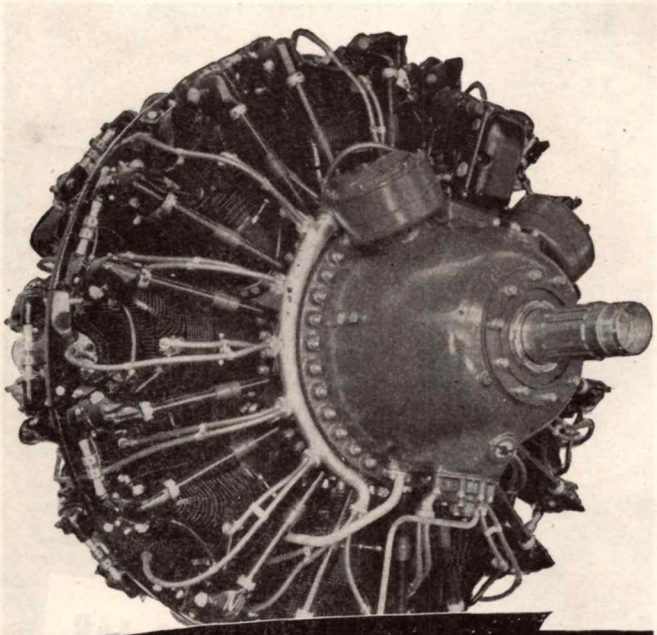
Along with positive resistance to continuous heat and corrosive elements—Carpenter Welded Stainless Tubing permits the use of *lighter gauges* without sacrifice of strength. And that means *less weight, more compact assemblies—and easier fabricating.*

Ever since the days when Welded Stainless Tubing was pioneered by Carpenter, we have been sharing our diversified experience with engineers and production men. For help with *your* particular heat or corrosion control problem—or for useful fabricating hints —get in touch with our Metallurgical Department.

YOU CAN USE THIS FOLDER to help you take advantage of the properties provided by Carpenter Welded Stainless Tubing. A note on your company letterhead will bring you this information on *physical properties, diameters and gauges, special shapes, specialty tubing,* etc. For your copy, drop us a line today.

THE CARPENTER STEEL COMPANY
Welded Alloy Tube Division • Kenilworth, N. J.

Carpenter
WELDED
STAINLESS TUBING



ENGINEERING AUTHORITIES SPECIFY DU-LITE for Engines

DU-LITE is used by leading airplane engine manufacturers. They have found that performance is actually improved by the use of Du-Lite finished parts. This is due to the fact that the deep penetration of Du-Lite provides maximum aid to lubrication.

The microscopic sharp corners, found on even highly polished bearing surfaces, are smoothed by the Du-Lite processing. The layer of black oxide produced absorbs and holds oil. This results in a lower coefficient of friction and prevents galling of closely fitted bearings during breaking-in periods.

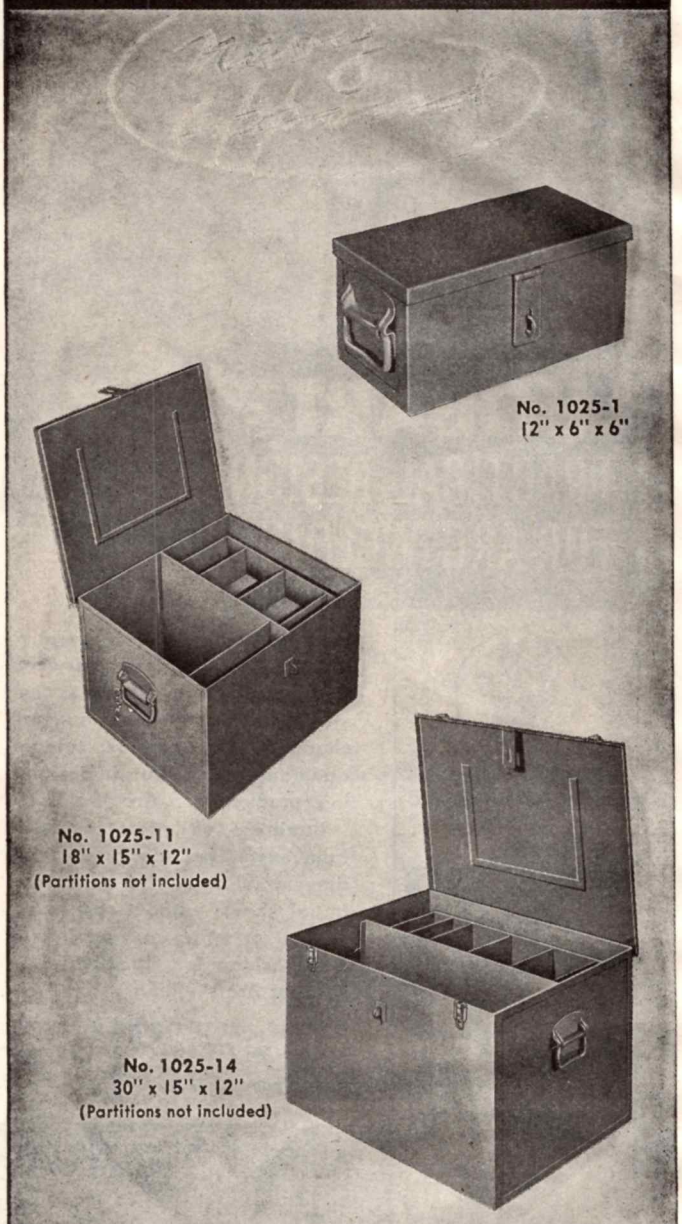
Du-Lite is used on other engine parts as a protection. Here again the deep penetration is important for it provides maximum rust resistance.

Du-Lite is the choice of engineering authorities because of these qualities plus its economy and the ease with which large volumes of work can be handled efficiently in a minimum of space. Du-Lite Engineers are located in the chief industrial centers and are at your service for consultation and advice. *Your inquiries will have prompt attention.*

DU-LITE CHEMICAL CORP.
MIDDLETOWN, CONNECTICUT

SPARE PARTS BOXES

As per specification 42 B 9 (INT) for shipboard use, Electrical and Mechanical. Navy grey finish.



—Send for Price List—

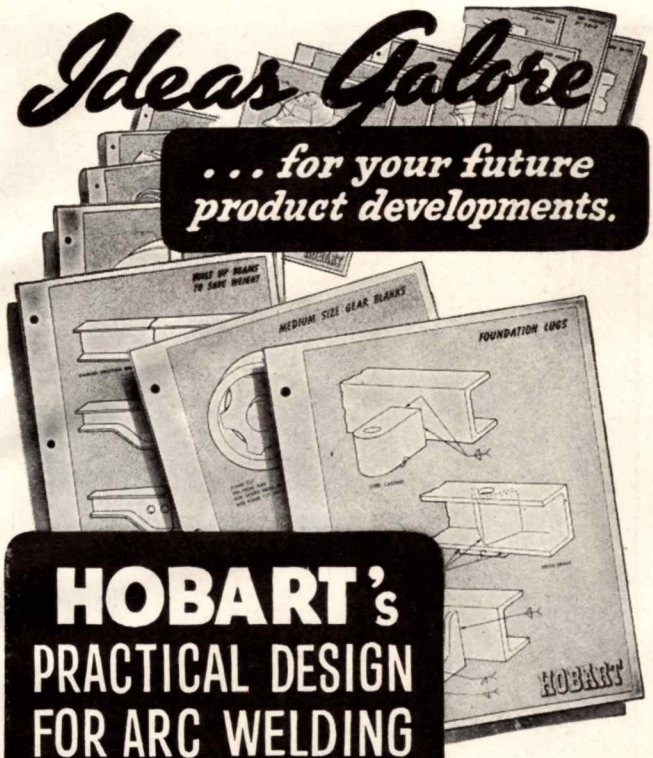
24 STOCK SIZES

Number	Length	Width	Height	Number	Length	Width	Height
1025- 1	12	6	6	1025-13	18	18	12
1025- 2	12	9	6	1025-15	24	15	12
1025- 3	12	12	6	1025-16	24	15	15
1025- 4	12	9	9	1025-17	24	18	12
1025- 5	18	9	6	1025-18	24	18	15
1025- 6	18	9	9	1025-19	24	18	18
1025- 7	18	12	9	1025-20	24	12	9
1025- 8	18	6	6	1025-23	30	15	9
1025- 9	18	15	9	1025-14	30	15	12
1025-10	18	12	6	1025-22	36	12	9
1025-11	18	15	12	1025-21	42	9	9
1025-12	18	12	12	1025-24	42	12	9

COLE STEEL EQUIPMENT CO.
349 BROADWAY NEW YORK

Ideas Galore

. . . for your future product developments.



HOBART's PRACTICAL DESIGN FOR ARC WELDING

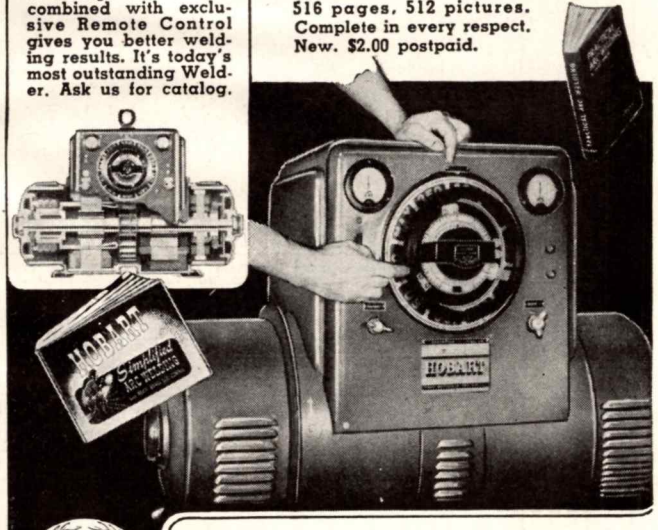
WHY SHOULD YOU CHOOSE HOBART "SIMPLIFIED" Arc Welding?

Hobart's compact design, 1000 combinations of voltage and current combined with exclusive Remote Control gives you better welding results. It's today's most outstanding Welder. Ask us for catalog.

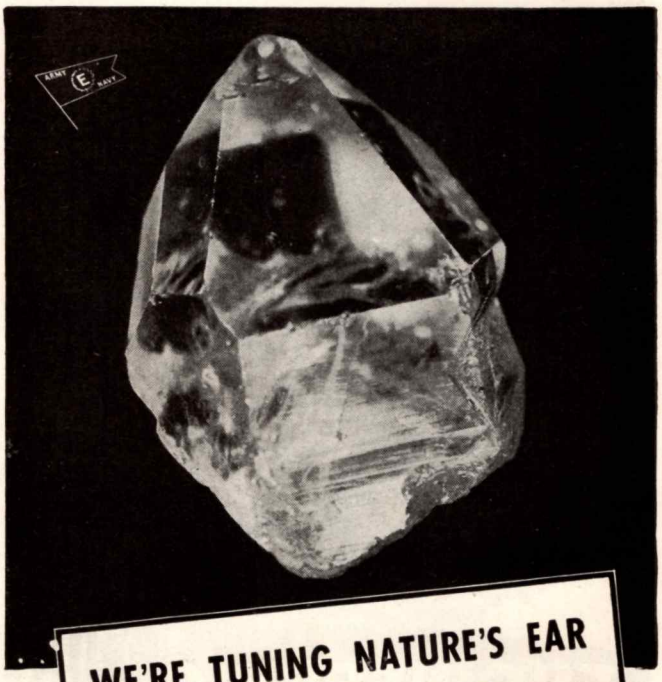
Here for the first time is a really practical welding design service. It shows hundreds of ways to use steel bars, plates, sheets, angles, channels, beams, pipe, tubing and flame cut sections in designing products for Arc Welding.

Hundreds of letters received from executives, designers, engineers telling us of its value. Initial sheets without cost, mail coupon or write on your letterhead asking for "Practical Design for Arc Welding".

HOBART ARC WELDING MANUAL
516 pages, 512 pictures.
Complete in every respect.
New. $2.00 postpaid.



HOBART BROTHERS CO.
BOX AD-113, TROY, OHIO



WE'RE TUNING NATURE'S EAR TO THE WAR EFFORT . . .

This piece of South American quartz crystal is remarkable for its piezo-electric properties. Ground so it responds to the proper frequency, it becomes a most important part of electronic devices used by our armed forces.

This grinding is a very "touchy" operation. Our special equipment and specially trained personnel are doing a fine job, we believe.

This is one of "Connecticut's" contributions to the war effort.

CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES INC.

MERIDEN, CONNECTICUT

● Our development engineers are glad to discuss electrical and electronic product ideas which might fit in with our postwar plans. Address Mr. W. R. Curtiss at the above address.

© 1943 GAI, Inc., Meriden, Conn.

Remember Me?

I'M THE GUY who looked at you from a USO poster a little over a year ago.

I'm the guy you forked over $34,000,000 for—so that, through the USO, you could let me and all my buddies know that someone home still thought about us—still cared enough not to want us to miss out on any of the things we were in uniform fighting for.

A hot cup of coffee, for example when you come in all grimy and tuckered out from a little "business" trip...

A club house with easy chairs to melt into and desks to sit at and write home and a dance floor and some decent girls to give us out here a little reminder of what it's still like back there.

You remember, don't you?

You probably dug deep for a lot of other things that year, too...for British War Relief, United China Relief, and so on. Well, this year it's going to be simpler for you. Because this year, seventeen war relief agencies have banded together into one great big campaign—the National War Fund. This time you are only asked to give *once* for *all* seventeen.

And take it from me, as one who ought to know, *that contribution you're going to make is one of the greatest things you can do to bring about victory.* Not just because part of it's going to the USO to do wonders for the morale of the fellows under arms, but because a good deal of it is going to help relieve distress at home through local agencies—as well as abroad, to help keep our allies in the fight.

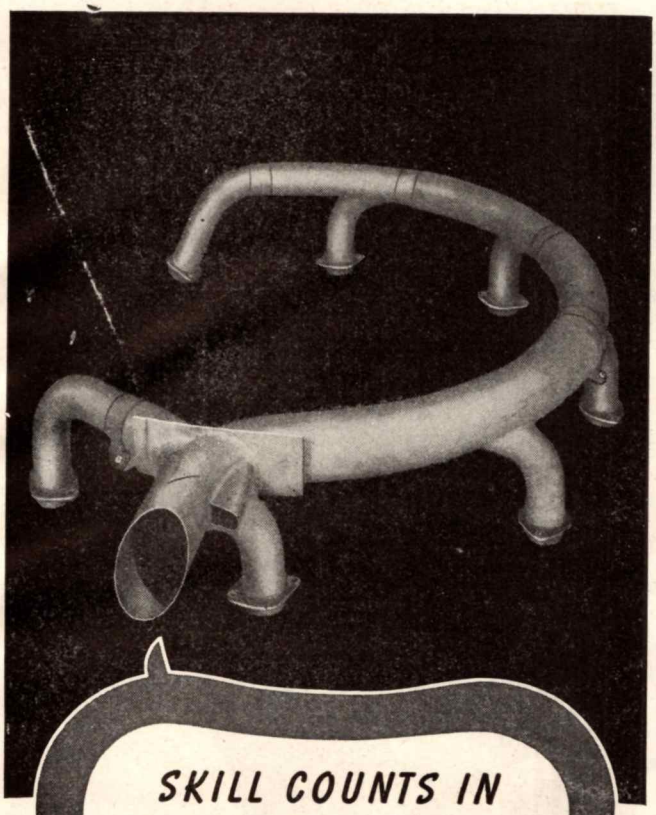
So when you're asked to give to the united campaign of the National War Fund and our community's own war fund this month, remember me. Every dollar you give helps me out in countless ways, and does its bit to bring me home sooner.

Give in a big way, will ya?

Give ONCE for ALL these

USO
United Seamen's Service
War Prisoners Aid
Belgian War Relief Society
British War Relief Society
French Relief Fund
Friends of Luxembourg
Greek War Relief Association
Norwegian Relief
Polish War Relief
Queen Wilhelmina Fund
Russian War Relief
United China Relief
United Czechoslovak Relief
United Yugoslav Relief Fund
Refugee Relief Trustees
United States Committee for the Care of European Children

NATIONAL WAR FUND



SKILL COUNTS IN AIRCRAFT WELDING

★ Kay Products Company occupies a unique position in the aircraft industry. Organized more than five years ago for the sole purpose of serving the Army Air Forces and leading airplane manufacturing companies, it has developed men and facilities for the production of aircraft parts and assemblies. Welding technique, particularly, has been carried to a high degree—and through recent increases in facilities and personnel, *we now offer the welding experience of this company to a limited number of new customers.*

KAY PRODUCTS COMPANY

4825 CABOT STREET, DETROIT, MICHIGAN

DIVISION OF TYLER FIXTURE CORP., NILES, MICH.

AIRCRAFT WELDING

CORROSION-PROOF

Photo Courtesy Bell Aircraft Corporation

with

KESTER ROSIN CORE SOLDER

● Corrosion—with terminal resistance and countless complications following in its wake—is "licked before it starts" when electrical connections are made permanent and secure with Kester Rosin-Core Solder.

● At Bell Aircraft and other plants coast to coast—assembling stout-hearted fighters and bombers and building their communications and control equipment—this important characteristic of Kester Rosin-Core Solder is helping to make American aircraft the finest in the world.

● Not only does the plastic rosin flux in Kester Rosin-Core Solder halt corrosion; it will not injure insulating material, disintegrate, or lose its fluxing power in any way, regardless of temperature extremes. That makes it standard at air bases everywhere—in Arctics and Tropics alike.

● All Kester fluxes are stable and scientifically correct. The acid flux in Kester Acid-Core Solder, used for general applications, gathers no moisture and assures a tight, clean, permanent union under all operating conditions.

● Kester's 44 years of highly-specialized solder experience is at your service, particularly in the selection of the proper combination of flux and alloy, strand and core size, best suited to every requirement. Write Kester engineers fully, without obligation.

☆ **BUY WAR BONDS** ☆

KESTER SOLDER COMPANY

4221 Wrightwood Avenue, Chicago, Illinois

Eastern Plant: Newark, N. J.

Canadian Plant: Brantford, Ont.

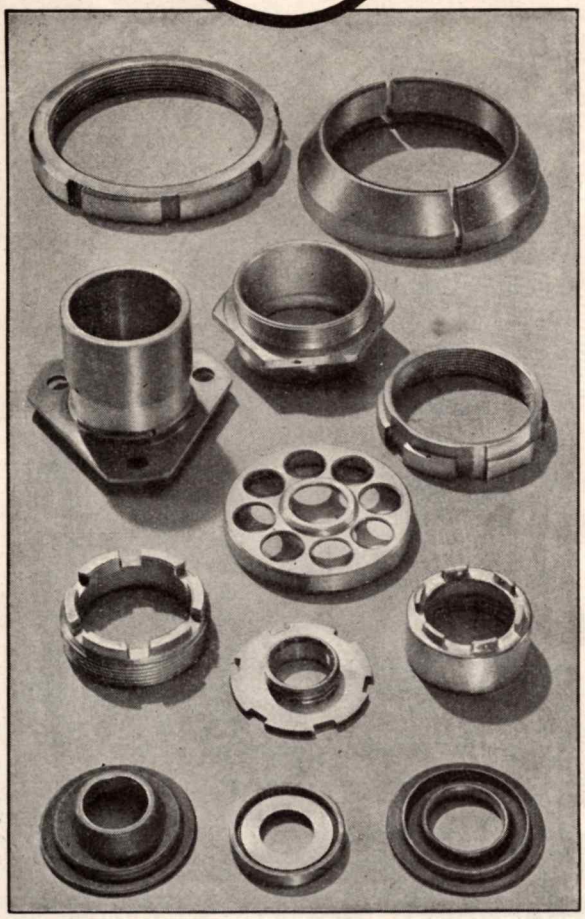
KESTER

Cored Solders

STANDARD FOR INDUSTRY

CHICAGO AIRCRAFT QUALITY

Screw Machine Products



HARDENED and GROUND to perfection!

These mighty midgets—"Chicago Aircraft Quality" Screw Machine Products—are playing a vital part in the performance of fighting ships, planes, tanks, trucks and industrial machinery . . . The line of screw machine work in which we specialize includes Hardening and Tempering, Heat Treating, Internal Grinding, External Grinding, Thread Milling, Thread Grinding, and all related operations.

ARMY E NAVY

THE CHICAGO SCREW CO.

ESTABLISHED 1872

1026 So. Homan Avenue Chicago, Ill.

Send for this FREE CATALOG

A wealth of information on cold-forged nails, rivets, screws and other items in hundreds of uncommon types. Specialties that will suggest to you how to improve the appearance or effectiveness of your product at minimum cost. Compiled by specialists in cold-forging since 1850.

JOHN HASSALL, INC.

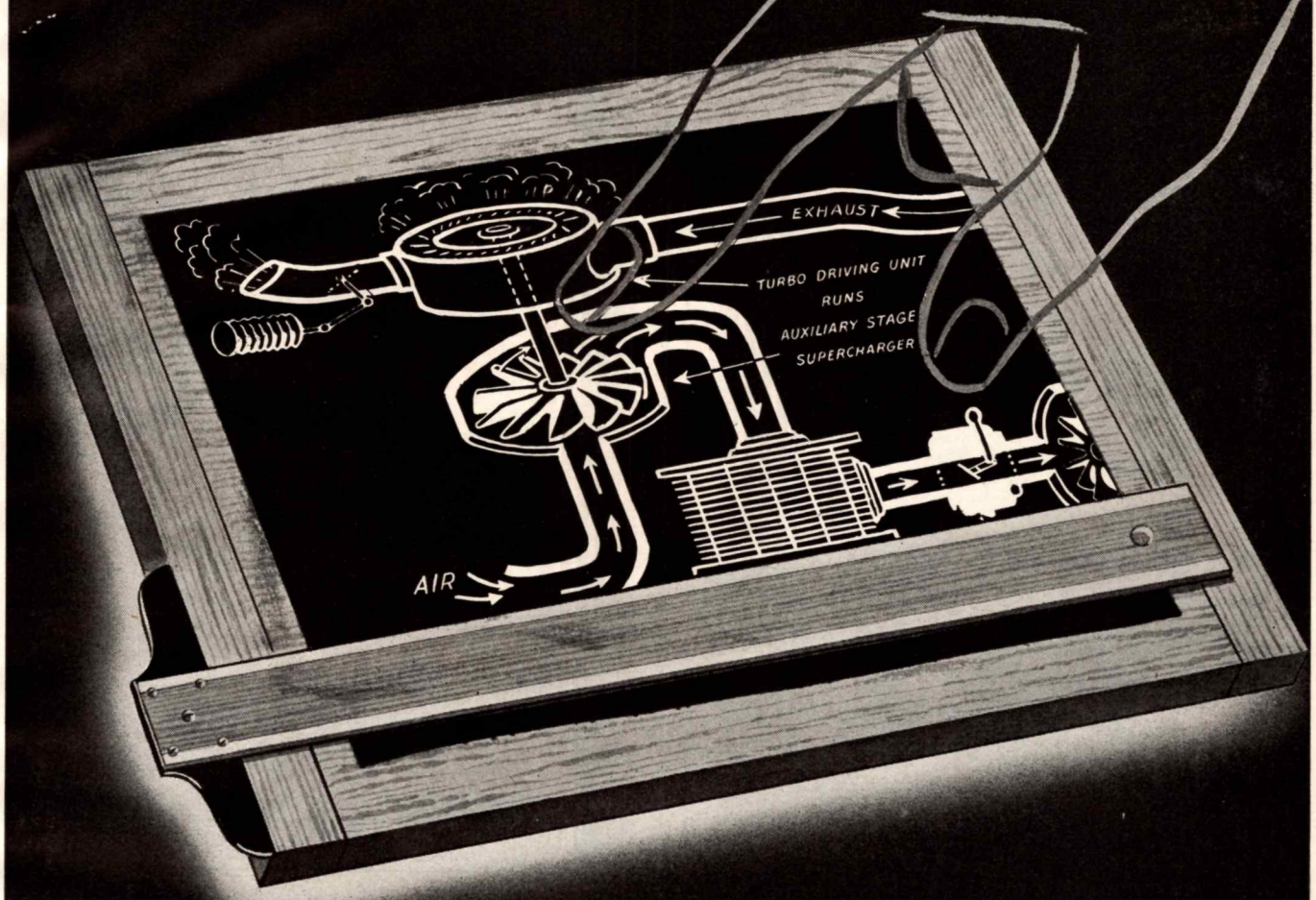
Established 1850

124 Clay Street • Brooklyn 22, N. Y.

SPECIAL NAILS RIVETS SCREWS

Hassall

A ROLLER BEARING AT 25,000 R.P.M. IN 300-DEGREE TEMPERATURES!



PROGRESS—*for Aviation...and for Hyatt*

Thanks to Turbo-superchargers, our planes now fly higher and faster...with "full military power"...at altitudes where the air is so thin that engines formerly lost four-fifths of their power.

"One of the toughest of all machines to design and build," its makers have said.

Ours was the job of supplying the roller bearing for a shaft spinning at 25,000 R.P.M. under 300-degree temperatures. This meant pioneering advances in the scientific heat treating of metals to prevent "growth." It meant improvements in grinding practices and refinement of surface finishing technique ...establishment of new manufacturing routines and inspection procedures.

The result: a new *super-precision* Hyatt Roller Bearing, with inner race peripheral speed of 10,000 feet per minute. 51 years of specialized roller bearing manufacturing, research and progress made it possible.

Have you a tough bearing assignment?

BUILD FOR THE FUTURE WITH WAR BONDS

HYATT BEARINGS

DIVISION OF

GENERAL MOTORS

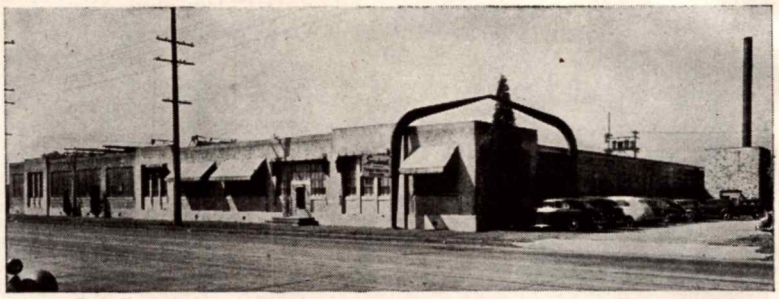
HARRISON, N. J.

TIMBER STRUCTURES INC.

Announces the Acquisition of

THE SPEEDWALL COMPANY

Formerly owned and operated by I. F. Laucks, Inc.



SPEEDWALL PLANT, 5038 First Avenue, Seattle, Washington.

TIMBER STRUCTURES, *Inc.* pioneers in prefabricated wood trusses, arches and columns for aviation housing, extends its field of service through the purchase and expanded operation of the Speedwall Company, Seattle, Washington, formerly a property of the I. F. Laucks Company.

The Speedwall Division of Timber Structures, Inc. will continue to bring to the field of aviation scientifically glued laminated spars, longerons and other aircraft parts. Write or wire your production inquiries to the nearest Timber Structures office.

•

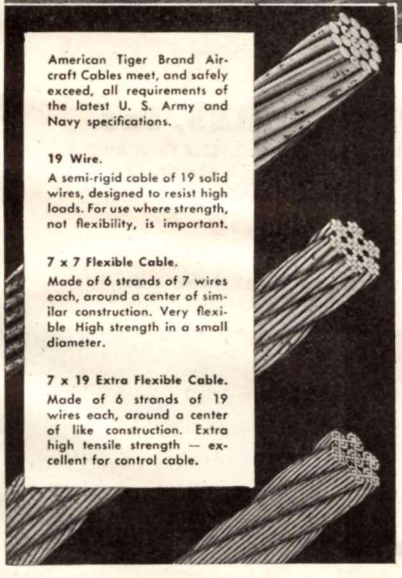
TIMBER STRUCTURES, Inc.

535 Fifth Ave. New York 17, N.Y. | 29th and N.W. Yeon Ave. Portland 8, Ore. | 5038 First Ave. Seattle, Wash.

Warehousing and crating facilities at Trenton, New Jersey

TIMBER STRUCTURES PLANT, Portland, Ore. *(below)*. **Located in the heart of the nation's structural timber area.** Yearly production in excess of 80 million board feet of prefabricated lumber. . . . Other plants at strategic points.

Hair-trigger **control** makes possible
world's deadliest low-level fighter


American Tiger Brand Aircraft Cables meet, and safely exceed, all requirements of the latest U. S. Army and Navy specifications.
19 Wire.
A semi-rigid cable of 19 solid wires, designed to resist high loads. For use where strength, not flexibility, is important.
7 x 7 Flexible Cable.
Made of 6 strands of 7 wires each, around a center of similar construction. Very flexible High strength in a small diameter.
7 x 19 Extra Flexible Cable.
Made of 6 strands of 19 wires each, around a center of like construction. Extra high tensile strength — excellent for control cable.

BOMBING and strafing at tree-top level—at speeds approaching 500 m.p.h. — this hell-raising fighter gave the Nazis the surprise of their lives when it first appeared on the battle scene.

Because it flies so low and so fast that the human ear can hear it only when it is overhead, only the luckiest shot can bring it down. But, unless the plane controls act instantly to synchronize with the pilot's lightning-quick reflexes, the dangers of a crack-up are great.

It is this kind of instant-acting, dependable control that is assured by American Tiger Brand Aircraft Control Cables. Their in-built qualities of high strength and high fatigue resistance make possible the sensitive, unfailing response indispensable for all precision flying and rapid maneuvering.

In these Control Cables are ideally combined light weight, minimum stretch, high resistance to abrasive wear and superior flexibility. All are of Excellay Preformed construction to insure flawless performance—under every condition of service.

AMERICAN *Tiger Brand* CONTROL CABLES

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York

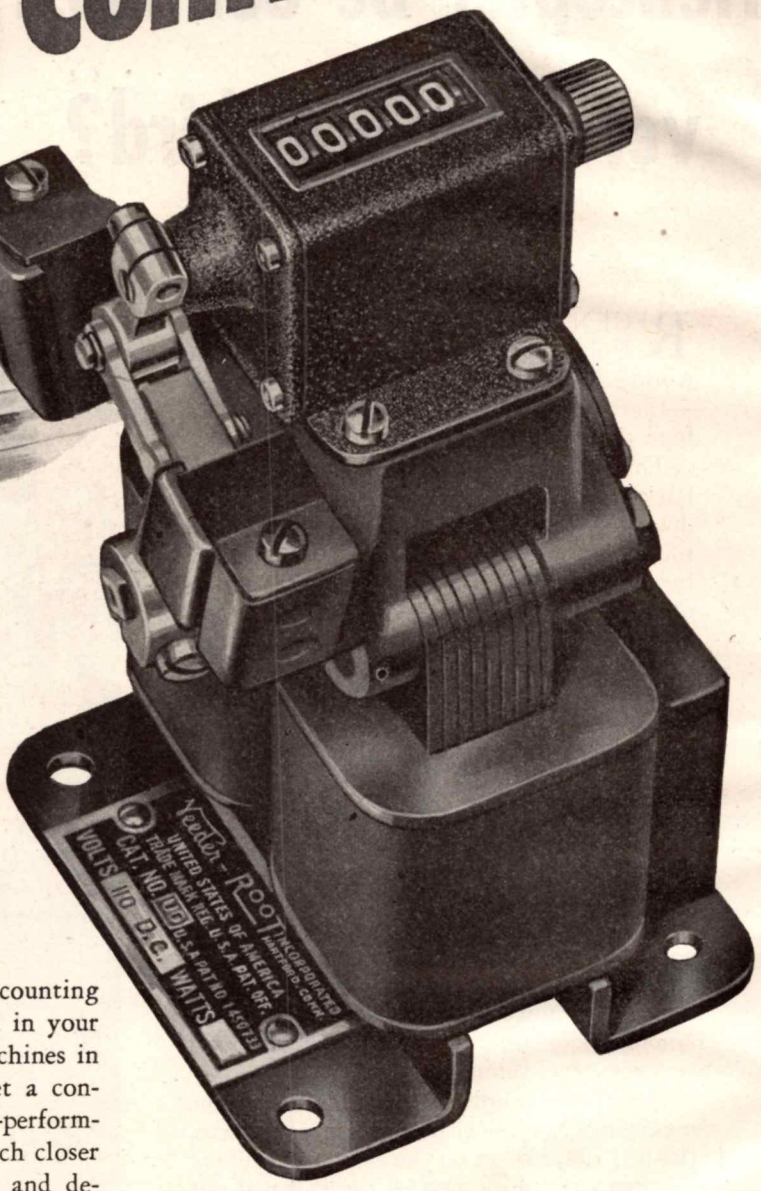
USS

UNITED STATES STEEL

This 5-inch "Control-Tower"

reports in your office on production machines in your plant

Take any number of these compact magnetic counting devices, and mount them on a central board in your office. Then hook them up to production machines in the plant . . . any distance away . . . and get a continuous, up-to-the-minute report on machine-performance. This report will enable you to keep much closer control of production . . . to keep machines and departments better synchronized . . . to keep maintenance-intervals from running overdue and into trouble. The many facts-in-figures supplied by Veeder-Root Counting Devices remove all guesswork on production, and keep you permanently posted on what's going on *right now*. These devices are easy to install, without interfering with production, and may be obtained in types to count on any machine in any terms or units you desire. Find out exactly how you can improve production with Veeder-Root *Control-by-Count*. Write.



Veeder-Root Remote Indicating Magnetic Counter . . . can be used with DC current, dry cells or storage batteries.

Veeder-Root Inc.
HARTFORD, CONNECTICUT

Will the Helicopter be our most versatile war-bird?

RECENT news releases divulged that the United States Army had placed the world's first large-scale order for helicopters —that an additional swarm had been ordered for use in anti-submarine warfare.

This revolutionary rookie flies forward, backward, sideways, straight up, straight down—hovers at any height. It can drop a ton of depth-charges or bombs, spot artillery targets, lay miles of signal corps wire in minutes. It can deliver breakable supplies and ammunition—even to troops in dense forest — can communicate by telephone (as Mr. Sikorsky is doing in the accompanying illustration), land messengers and haul up wounded men.

Muffled to relative quiet, it can perform night missions behind enemy lines. On pontoons it can take off from a freighter's deck for liaison and observation duty—can land on water, swamp, snow, or back on deck.

The modern helicopter's wartime uses are countless, as are the improvements in design and construction through which it has been developed toward perfection. Prominent among them are the many applications of seamless steel tubing.

In rotor standards, fuselage frames, engine mountings, landing gears and pontoon braces, the helicopter relies on the same steel tubing that has proved its mettle in so many of our modern fighters and bombers. For rigidity, high strength-weight ratio and rugged durability — proved in combat service — plane manufacturers have put the seal of their approval on SHELBY Seamless Aircraft Tubing.

Keep fully informed on aircraft tubing. Write for your copy of Bulletin No. 16.

SHELBY SEAMLESS AIRCRAFT TUBING is available in all standard sizes and sections, made to exacting government specifications by the most modern process, developed in the plants of the world's largest manufacturer of tubular products.

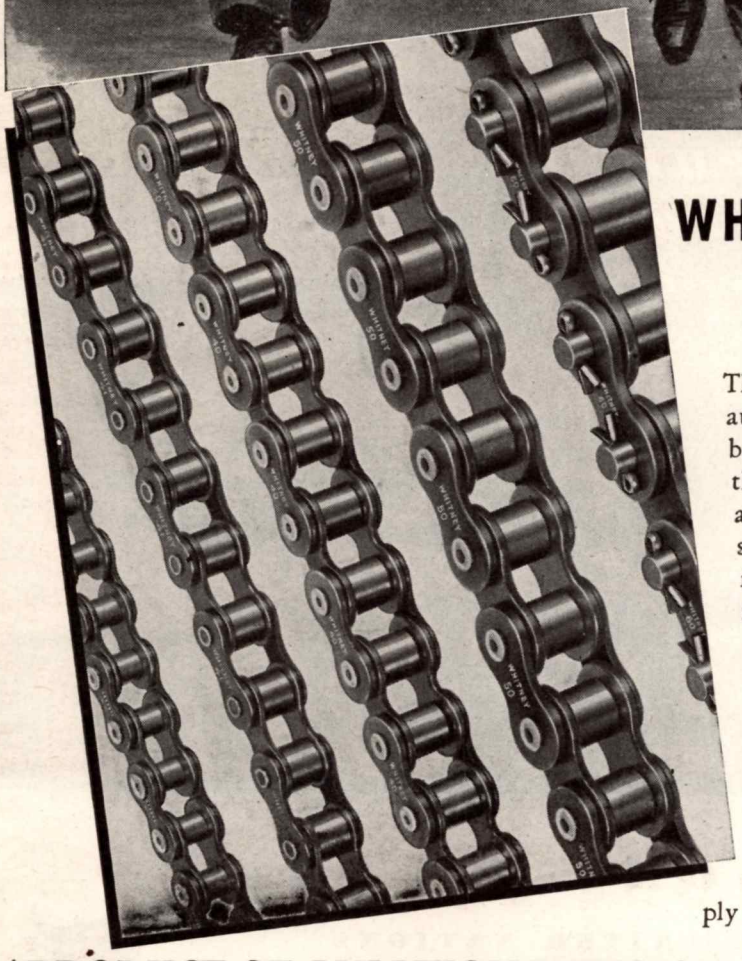
NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* United States Steel Export Company, New York

UNITED STATES STEEL

"...man your planes"



WITH WHITNEY AIRCRAFT CHAINS*

on all vital mechanisms and controls

The "mechanical crew" of a military plane . . . automatic pilot, turret drives, power plant controls, bomb displacement gear, and other components . . . these should be picked for the same qualities by which are picked the men who use them: dependability, speed of reflex, and plenty of plain guts in tough going. So into these mechanisms and controls, on many famous planes, Whitney Chains and Sprockets are chosen to translate the crew's commands into *positive, instant action.*

And today there is an added advantage to the specification of Whitney Chains . . . the direct, personal contact with engineers of The Whitney Aviation Division, through which are placed at your disposal all of Whitney's technical and manufacturing resources, to focus directly on your problems. Simply say when you wish to see a Whitney engineer.

***PRODUCT OF AVIATION DIVISION of THE WHITNEY CHAIN & MFG. CO.**

HARTFORD 2, CONNECTICUT

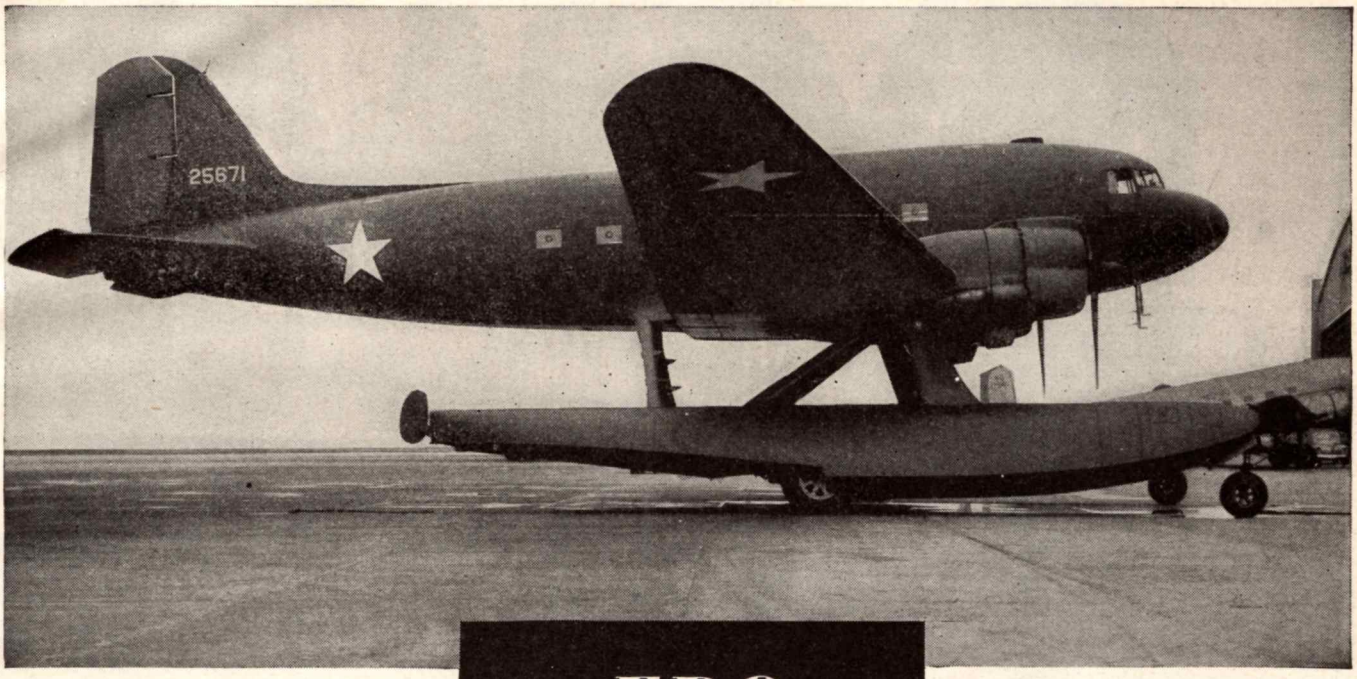
SOMETHING REALLY NEW!

Douglas C-47 "Skytrain" on Edo Model 78 Amphibious Float Gear

READY TO SERVE IN

TRANSPORTATION OF COMBAT TROOPS • ORDNANCE • SUPPLIES

EVACUATION OF WOUNDED

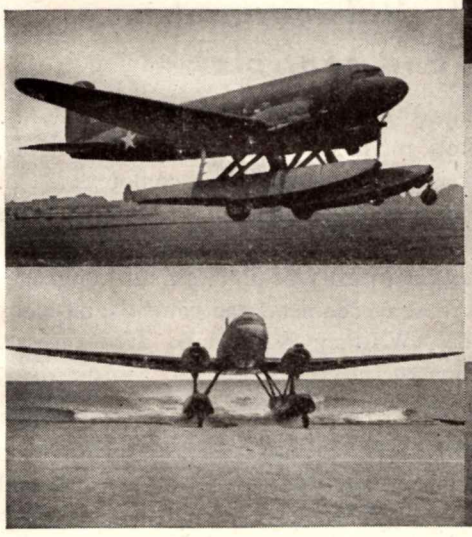


ALL-ROUND SERVICE

EDO AMPHIBIOUS FLOATS

with retractable wheels

ON LAND AND SEA



EDO FLOAT GEAR

SERVES THE UNITED NATIONS

EDO AIRCRAFT CORPORATION, 401 SECOND STREET, COLLEGE POINT, L. I., N. Y.

for Your Screw Driving Army

NO PRACTICE NEEDED TO DRIVE PHILLIPS SCREWS . . .

It's no problem to replace men who have left your screw driving army for the fighting front, *if you use Phillips Recessed Head Screws.* Anybody can "take over", without training, and do a good job!

The scientifically designed Phillips Recess makes screw driving fool-proof. It automatically centers the driving force and eliminates all driving troubles . . . fumbling, wobbly starts . . . slant-driven screws . . . burred and broken screw heads . . . and dangerous screw driver skids.

Screw and driver "become one unit", making such efficient use of turning power that driving is much easier and faster, regardless of driving method. And, power driving is made practical.

Compare the cost of driving Phillips and slotted head screws. You'll find that it actually costs less to have the advantages of the Phillips Recess!

PHILLIPS *Recessed Head* SCREWS

KEY TO FASTENING SPEED AND ECONOMY

The Phillips Recessed Head was scientifically engineered to afford:

Fast Starting – Driver point automatically centers in the recess . . . fits snugly. Screw and driver "become one unit." Fumbling, wobbly starts are eliminated.

Faster Driving – Spiral and power driving are made practical. Driver won't slip out of recess to injure workers or spoil material. (Average time saving is 50%.)

Easier Driving – Turning power is fully utilized by automatic centering of driver in screw head. Workers maintain speed without tiring.

Better Fastenings – Screws are set-up uniformly tight, without burring or breaking heads. A stronger, neater job results.

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOL

21 SOURCES

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Con
Whitney Screw Corp., Nashua, N. H.

The Light that MUST NOT FAIL

Pull . . . Pull . . . Slide . . . Pull and pull again. So it goes, as yards of silken safety chute pass over a frosted glass window. Through it, a powerful light blazes while keen eyes search every stark detail of triple-stitched seams, alert to detect any dropped stitch, break or snarl. This is a light that must not fail . . . for here, truly, life hangs on a thread. ☆ ☆ ☆ Switlik workers are exceedingly proud of their contribution to the jumper's serene confidence during those moments of literal "suspense" between plane and earth. ☆ ☆ ☆ The skill these craftsmen have developed is a tribute to Switlik engineering methods in designing "the best parachute that can be made" . . . and setting new records, as well, for production and delivery of this Switlik Safe-T-Chute. ☆ ☆

SWITLIK

SAFE-T-CHUTES

Air Power is winning the war
. . . The more Bonds you buy
. . . the more hours they fly!

SWITLIK PARACHUTE COMPANY
Trenton, New Jersey

Copyright 1943, Switlik Parachute Co.

THE Wonders of WOOD AND GLUE

THE GLUE THAT HELD FOR 6,000 LONG YEARS

STATUES FOUND IN THE RUINS OF BABYLON HAD THEIR IVORY EYES GLUED IN WITH A BITUMINOUS ADHESIVE.

THE LONG WAIT

FRANK PERKINS DISCOVERED VEGETABLE GLUE IN 1906. THE **FIRST** DISCOVERY IN ADHESIVES IN 30 CENTURIES. THE WORLD WAITED A LONG TIME FOR PERKINS' DISCOVERY. TODAY THE PERKINS GLUE COMPANY MAKES ALL TYPES OF ADHESIVES. WE ARE ANXIOUS TO HELP YOU WITH YOUR PROBLEMS ON ADHESIVES.*

THE U.S. USES ONE-HALF OF ALL THE LUMBER CUT IN THE WORLD.

5,000,000 TONS OF METAL WILL BE SAVED IN 1943 BY CONVERSION TO WOOD

ENOUGH TO BUILD 100 BATTLESHIPS OF THE SIZE OF THE U.S.S. WASHINGTON.

In order to broaden the post war market for the wood-working industries the Perkins Glue Company is using this series of advertisements to call the attention of industrial America to the miracle of wood.

ONE RELIABLE SOURCE FOR RESIN, CASEIN, AND VEGETABLE ADHESIVES

***Use PERKINS BONDING SERVICE**

You may use Perkins Bonding Service in three ways

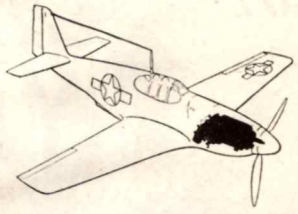
1. Write for data sheets on any of the Perkins Resin Glues.
2. Call on a Perkins Technician for individual consultation, or
3. Write for the booklet that describes all Perkins Resin Glues and also describes Mixing and Spreading Equipment.

ACT NOW, on at least one of these. **Obviously, no obligation. Perkins Glue Co., 601 Cannon Avenue, Lansdale (near Philadelphia), Pennsylvania. In Canada, Perkins Glue Company of Canada, Ltd., Kitchener, Ontario.**

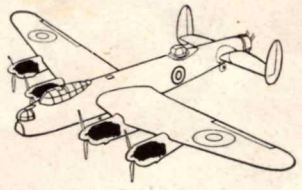
Warehouses in JAMESTOWN • GRAND RAPIDS • SAN FRANCISCO • LOS ANGELES • CHICAGO • ST. LOUIS • GREENSBORO • TACOMA • PORTLAND

Did you know this family secret?

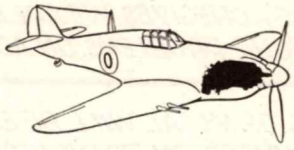
The fighting weapons shown here range from four-motor bombers to the amazing PT boats. Yet all of them have one important thing in common —they are powered with precision-built engines by Packard.



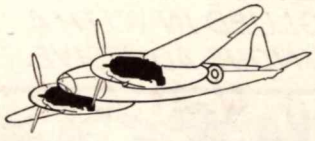
High flying Mustang! Mustang pilots now have two more miles of sky to fight in—a deadly fighter has been made even more deadly—thanks to the new Packard-built Rolls-Royce engine with its 2-speed, 2-stage super-charger. Performance at lower levels has been stepped up as well.



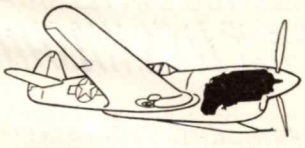
"To Berlin—with the compliments of Coventry" might well have been scrawled on the block-busters dropped by England's multi-ton Lancasters. These four-motored giants put Packard-built Rolls-Royce engines to the acid test on their long-range sweeps over German targets.



"Can opener" is the name given the Hurricane—armed with 40 mm. guns—for its spectacular tank-busting feats in North Africa. Many a Packard-built Rolls-Royce engine has helped to write the fighting log of this deadly British fighter.

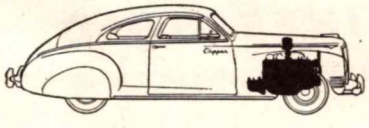


Too fast to catch! Swift deHavilland Mosquito bombers rely on pure speed to complete their missions unscathed. With two Packard-built Rolls-Royce engines to supply their power, these long-range streaks are giving the Luftwaffe plenty of headaches.



Back in "coffin corner" went Rommel's Axis divisions as U. S. Warhawks helped to pound them relentlessly. Packard workers heard the news with cheers, for they build the Rolls-Royce engines that power these planes.

"Streamline pile-drivers loaded with dynamite!" That's what men in Uncle Sam's famed mosquito fleet call their PT boats. The hit-and-run PT's, powered by Packard super-marine engines, are making a terrific dent in Axis tonnage.



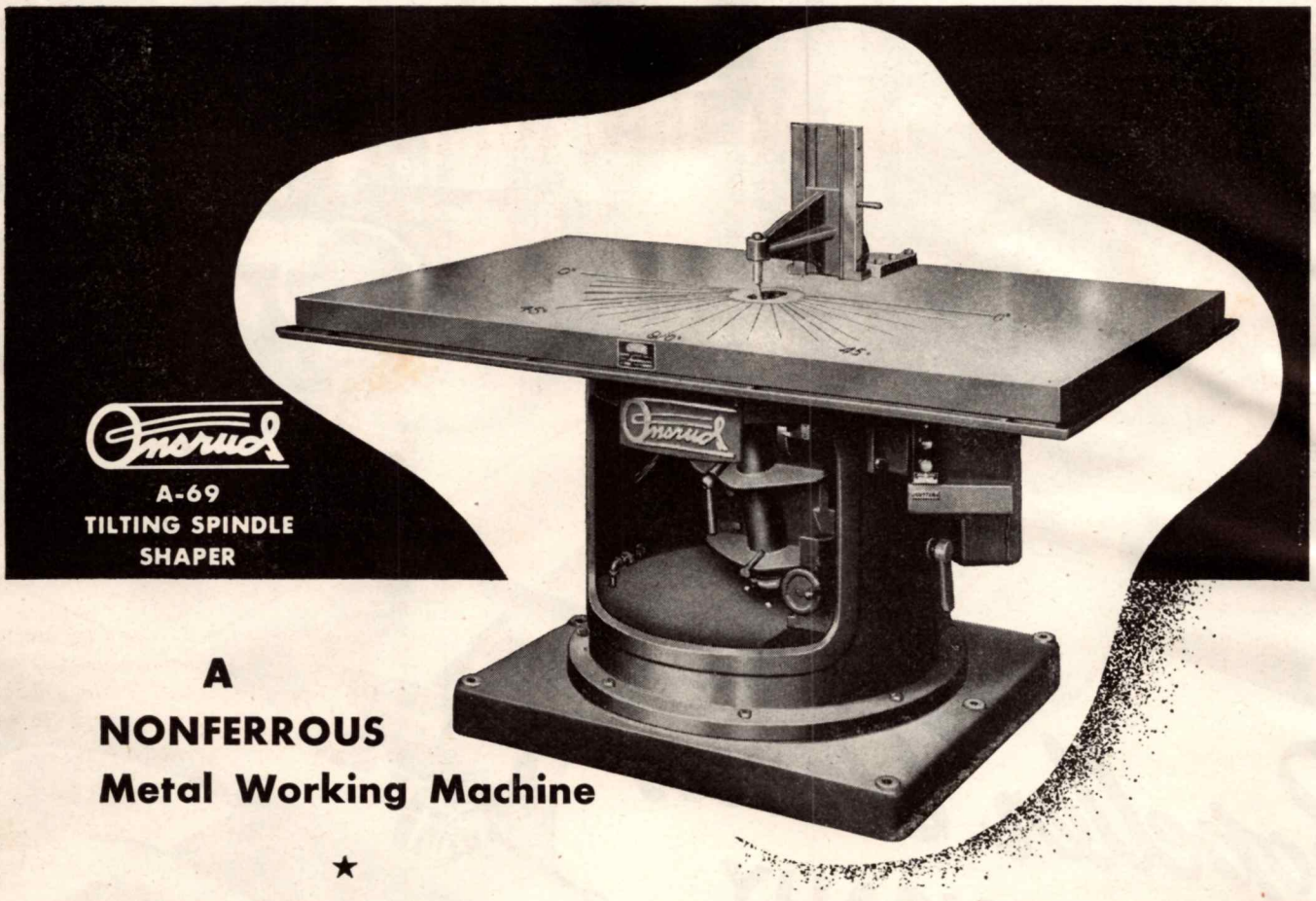
Duration durability. Packard Clipper quality counts double today, for Packard craftsmen are now building fighting engines instead of cars—acquiring precision skills that will mean even finer post-war Packards. Meanwhile, Packard dealers have ample parts and a special "car health" plan to keep your car up to par.

PACKARD

Precision-built Power

•

ASK THE MAN WHO OWNS ONE

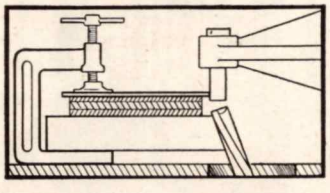


A NONFERROUS Metal Working Machine

★

To Mill Constant or Varying Bevels . . . . . and to Profile or Trim

On this Onsrud machine, the cutter spindle tilts forward or backward and may be set to make any angle with the table up to 20° off-vertical. The cutter is directly driven by a 10,800 RPM high cycle electric motor. Thus the A-69 Tilting Spindle Shaper makes easy and fast the work of accurately beveling nonferrous materials. Setup is simple and templates or patterns used in conjunction with the tilting spindle shaper solve many production problems.



The relation between the work and the cutter, guide pin and pattern is schematically illustrated here. The cutter is set at an angle to produce the bevel desired. The A-69 eliminates the need for special cutters or complex fixtures to produce any bevel within the range of the spindle's tilt.

Trimming and profiling are other operations to which the A-69 is particularly well adapted.

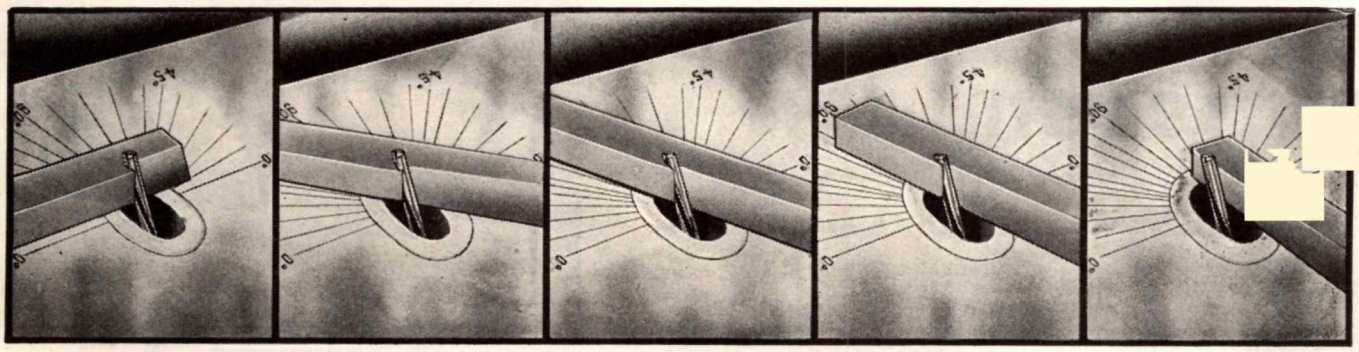
Bevel angle may be varied without changing the spindle angle by simply changing the angle of approach at which work is fed. With this "sweep" technique it is relatively easy to produce varying bevels on work.

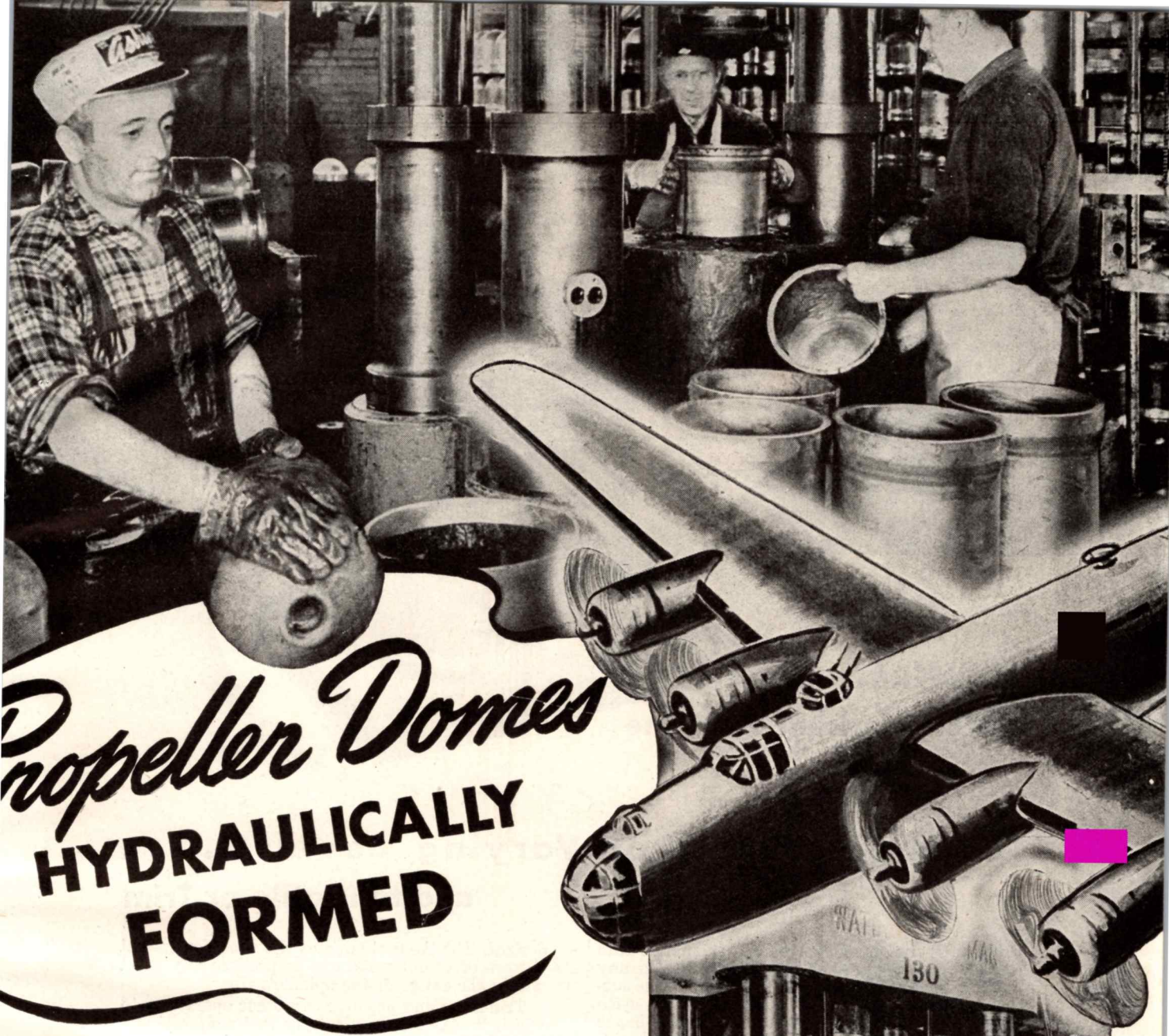
Your copy of a free bulletin describing this unique, versatile machine will be sent on request. Write today.

ONSRUD MACHINE WORKS, Inc.
3935 Palmer Street, Chicago 47, Illinois
Sales Offices in all Principal Cities

The illustration below shows how "sweeping" the work around the tilted spindle during feed produces a varying bevel. Note that the spindle angle remains unchanged—bevel variation is produced by change in angle at which work is fed.

Patent No.
1-991-623
469-158

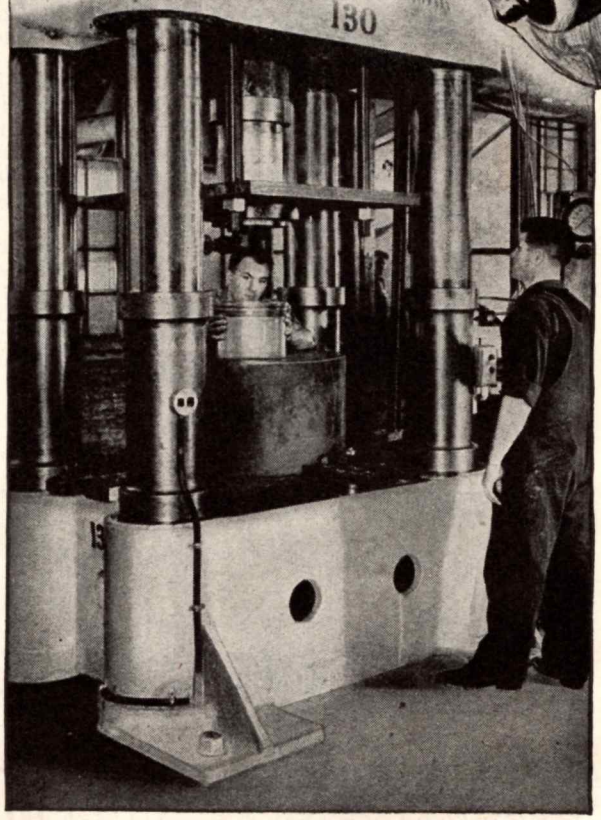




Propeller Domes HYDRAULICALLY FORMED

The Watson-Stillman 1500-Ton Forming Press Solved Production Problem in Aircraft Industry

With the production of aircraft speeding toward the 6,000-a-month goal, many technical problems faced Industry. One was the deep-drawing of aluminum alloy (61-S) for the housing or "dome" of hydromatic propellers. In the plant of the Worcester Pressed Steel Company, this problem was solved with the use of the Watson-Stillman 1500-ton metal forming press. During the past three years more than three million pounds of sheet aluminum have been fabricated at this plant. The complete line of Watson-Stillman Hydraulic Presses is illustrated and described in Bulletin 110-A. Copies are available on request. The Watson-Stillman Co., Roselle, N. J.



WATSON-STILLMAN

Hydraulic Machinery and Equipment

SPECIFICATIONS

VERTICAL OPENING—66"
STROKE—36"
DISTANCE BETWEEN COLUMNS—40"
CAPACITY OF STRIPPING CYLINDER—60 TONS
MOTOR—75 H.P.

4392

For Victory ★★★ Let's all be Scrappers

What's Behind All This?

Behind this door is a veritable treasure chest. Not of gold or precious stones, but of something far more valuable. Within are to be found degrees of skill, ingenuity and craftsmanship rarely matched.

No new and untried group of craftsmen, this, but men honored by long, successful accomplishment.

This may be a Door of Opportunity for you, for the needs of war or the requirements of peace.

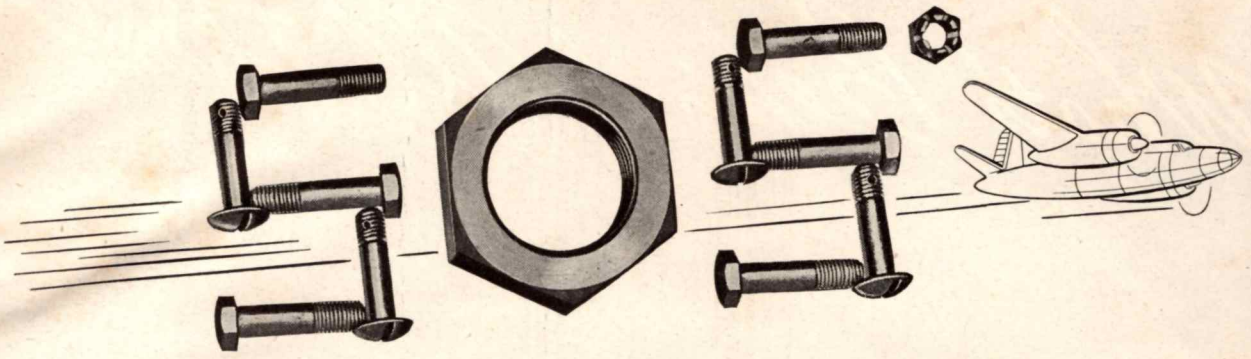
OLOFSSON

Designers of Tools, Dies, Jigs and Fixtures
Designers and Builders of Special Machines

OLOFSSON TOOL AND DIE COMPANY

LANSING, MICHIGAN

Chicago Engineering Office, 600 South Michigan Avenue



SOS Source of Supply for Aircraft Manufacturers

"PHONE SUPPLY DIVISION" has become a by-phrase in the plants of American Aircraft Manufacturers when sudden shortages of nuts, bolts, turnbuckles or parts, threaten to interrupt production schedules.

And that's only natural, because for more than eleven years it has been our business to help plane manufacturers out of tight spots by rendering "same day" service on items needed in a hurry.

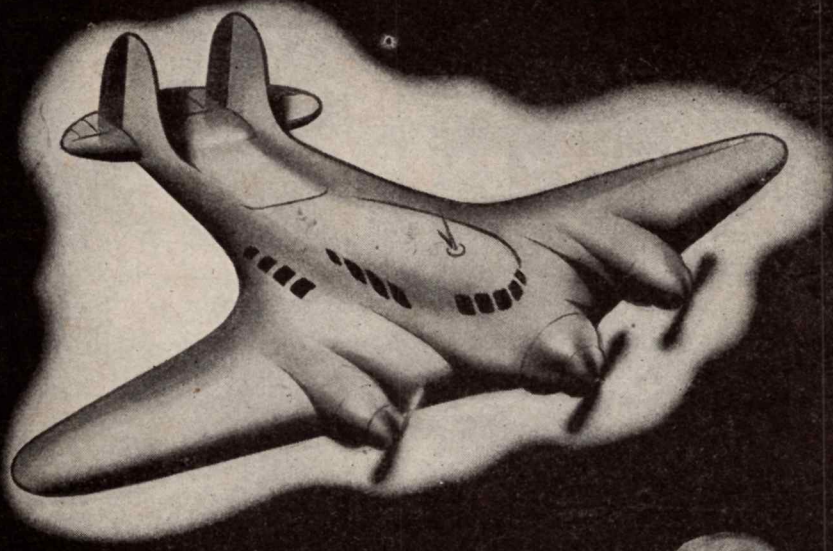
Through those years this business has grown steadily. Two warehouses are now operating—a third is being constructed. So, we're not only equipped to render vitally needed service now, but are preparing ourselves to be of definite assistance to manufacturers in the critical period after Peace is declared.

LAMBERT AIRPORT,
ROBERTSON, MO.
PHONE: TERRYHILL 5-2902 (ST. LOUIS)

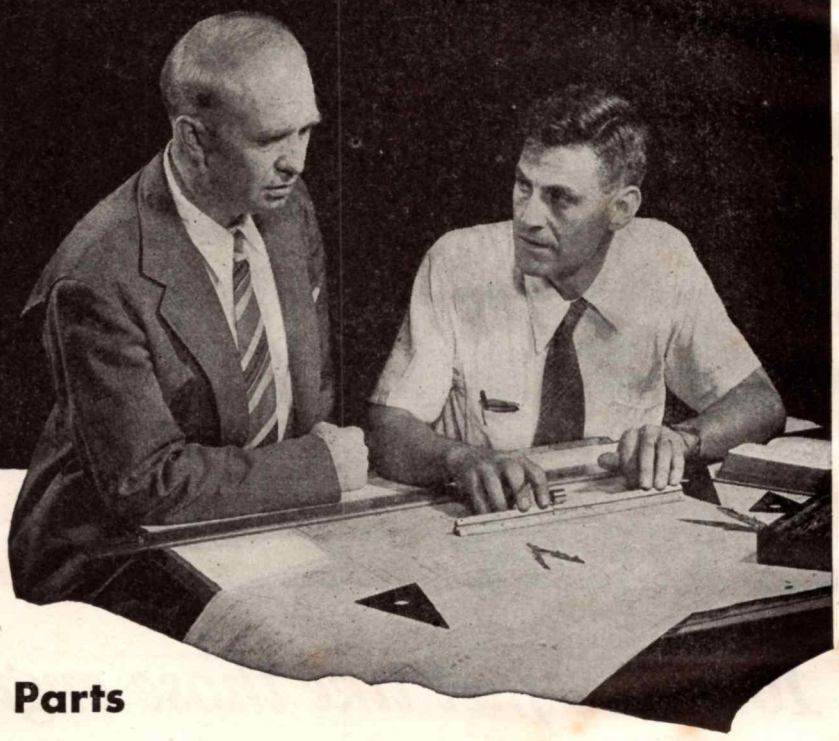
108 W. GRAND AVE.,
OKLAHOMA CITY, OKLA.
PHONE: 3-6224

SUPPLY Division Inc.
LAMBERT AIRPORT ROBERTSON, MO.

21



PLANNING YOUR NEW PRODUCT?



Get help from
DIAMOND G

Lock and Flat Washers
Expert Heat Treating
Manufacturer of Small Parts

Planning your product for the future? Does it include lock and flat washers, require heat treating or need small metal parts? Then count on Diamond G for everything . . . plus real engineering service.

The Diamond G man will be glad to work with you and advise you on the correct use of the complete line of washers we manufacture. Everything from No. 0 (1/16" IDO) to 2" lock washers . . . steel, cadmium-plated, bronze, or stainless steel . . . AN 935 series as well as aviation flat washers.

If heat treatment of small parts is an important step in manufacturing your future products the Diamond G man can place at your disposal the possibilities of more speed in heat treating small parts up to 2" x 2" . . . fewer rejects . . . lower costs.

A call for the Diamond G man will give you plenty of technical advice and service on how you can use the modern facilities of the Diamond G plant in manufacturing your future products. Our methods of manufacturing have always been and will be far ahead of the field . . . and we are confident we can help you now and in the future. For information about parts, springs, washers, etc., write . . .

GEORGE K. GARRETT CO.
D & TIOGA STS., PHILADELPHIA

DIAMOND G LOCKWASHERS

©1943, The Studebaker Corporation

"You purr just like those engines Dad builds!"

They're Studebaker-built Wright Cyclones for the famous Boeing Flying Fortress

SOLDIER HARRY RYAN and his father were fellow craftsmen in the Studebaker factory prior to Pearl Harbor. They comprised one of the many father-and-son teams that have been a unique Studebaker institution since 1852.

Large numbers of the younger men, who once were Studebaker craftsmen, are now using instead of building military equipment. In many instances, their fathers, and other older members of their families, are producing Flying Fortress engines, multiple-drive military trucks and other war matériel in the busy Studebaker plants.

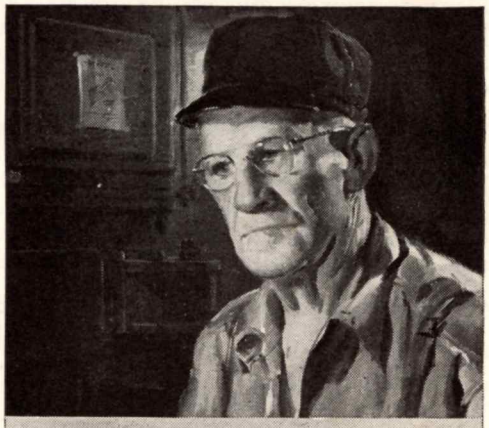
For generations, a tradition of Studebaker employment has existed in Studebaker's home community. This has resulted in a quality of craftsmanship unmatched in the automotive world.

This craftsmanship is now being utilized to the limit, on behalf of our Nation and its Allies. It will provide finer Studebaker motor cars and motor trucks than ever before for civilian use, after Victory comes.

BUY U. S. WAR BONDS

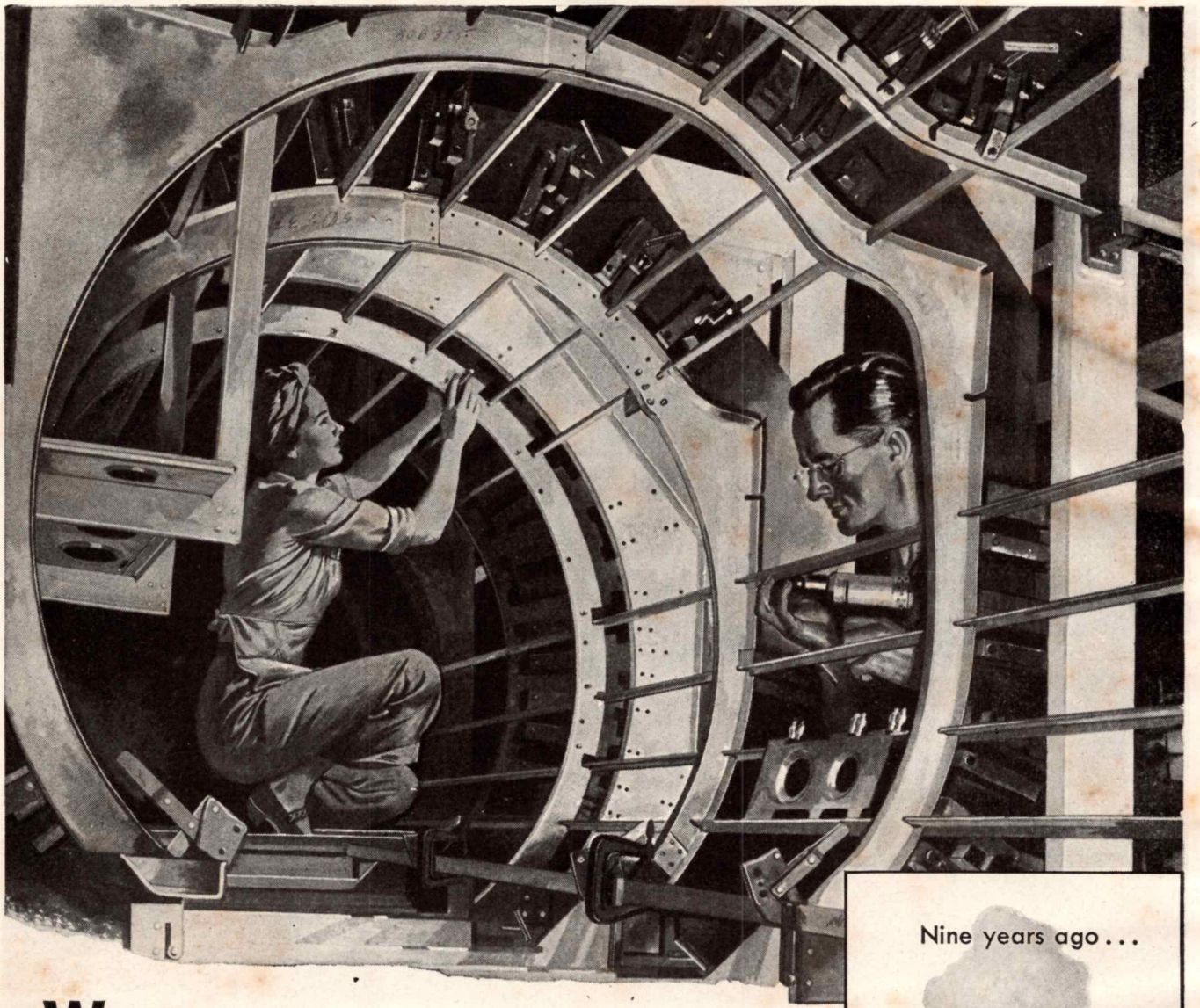
STUDEBAKER

Builder of Wright Cyclone engines for the Boeing Flying Fortress, big multiple-drive military trucks and other vital war matériel



"Always give more than you promise"

That Studebaker watchword has been observed for 20 years by craftsman Henry C. Ryan. He is helping to build Cyclone engines for the Flying Fortress in one of Studebaker's aircraft engine plants. Some day, he and his soldier son, Harry, hope to build Studebaker cars again for you.



What is happening at Northrop today will help bring Victory sooner

'WAY BACK IN 1930...there was an airplane called the Northrop "Alpha"... the first all-metal stressed-skin monoplane to embody the multicellular wing structure.

The "Alpha" is important to America. It ushered in the era of the modern low wing all-metal monoplane.

Thereafter, the Northrop group created the Northrop "Gamma"—first airplane with the now-familiar split trailing edge landing flaps. Faster, even more aerodynamically "clean" than the "Alpha", the Northrop "Gamma" set transcontinental air-mail records. With military modification, *the "Gamma" became the world's first airplane to be used as an attack bomber.*

This same Northrop group then built *the Northrop 3A — pioneer pursuit plane flying over 300 miles per hour.*

Later, the group designed and built the N3-PB patrol bomber—still the swiftest military seaplane fighting on any front.

Such are some of the past achievements of the Northrop group—and that same group of Northrop talents is hard at work for America today. What is happening at Northrop cannot be fully discussed right now . . . but you may be confident of this:

Northrop aerodynamicists, production engineers and airplane-building craftsmen are turning out in production quantities new Northrop warplanes to carry on the tradition.

What can one individual do? Warplanes hatch from War Bonds. Buy more War Bonds every payday!

Nine years ago...

In 1934, the Northrop group designed and built the Northrop 3A, pioneer of fighters flying over 300 miles an hour. To this low wing pursuit with its clean lines, retractable landing gear, and split trailing edge landing flaps may be traced the ancestry of many of today's fighters.

NORTHROP *Aircraft, Inc.*

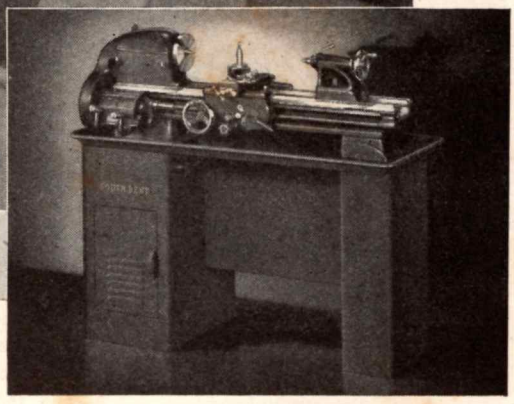
NORTHROP FIELD, HAWTHORNE, CALIFORNIA

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

Women

ARE TAKING THIS WAR SERIOUSLY

SOUTH BEND LATHES



9" swing, South Bend Engine Lathe

With grim determination thousands of American women are doing their best to fill men's shoes. Eagerly they bend their shoulders to wartime tasks—for no sacrifice is too great if it hastens the return of their men from the fighting fronts.

In hundreds of vital war plants, women are operating South Bend Lathes with surprising results. On all kinds of jobs, they have kept up production and maintained established standards of precision. In some factories whole batteries of South Bend Lathes are humming under the guidance of feminine hands.

Since World War I, women operators have preferred South Bend Lathes. Their nimble fingers find the convenient controls well suited to their sensitive touch. They like the fully enclosed design. And, most of all, they appreciate the ease of operation that prevents fatigue and makes the workday seem shorter.

South Bend Engine Lathes and Toolroom Lathes are made in five sizes: 9" to 16" swings, with 3' to 12' bed lengths. The Turret Lathes are made with 9" and 10" swings. Write for Catalog 100C which describes all sizes and types of South Bend Lathes.

BUY WAR BONDS

SOUTH BEND LATHE WORKS

Lathe Builders for 37 Years
SOUTH BEND 22, INDIANA

TOP FLIGHT
IN TOOLS

Air victories begin at home. Metals from mines. Planes from production lines. Crews from training fields. All combine to form a hard-hitting air force. From mine to completed bomber, before the take-off and after, tools are necessary. Tools that are adaptable, dependable, top flight in every way . . . Williams' Tools! For over sixty years mechanics and maintenance crews have used them with confidence. Williams will continue to make such tools to serve the needs of peace-time motoring and flying as those of wartime are now being served. Williams looks to the future, anticipates your after-Victory needs.

J. H. Williams & Co., Buffalo, N. Y.

WILLIAMS
SUPERIOR DROP-FORGED TOOLS

DROP-FORGINGS & DROP-FORGED TOOLS

"HOW TO SELECT AND USE WRENCHES" CONTAINS MANY HELPFUL SUGGESTIONS. IT'S YOURS FOR THE ASKING — JUST **WRITE**

POWERPLANT CONTROL SYSTEMS

(*Continued from page* 459)

been known to fail when installed on long rods with ball bearing rod ends. The freedom afforded the control tube by the relatively friction-free bearings allows the rod to vibrate bow-string-wise on the clevis bolts, thereby inducing fatigue failure at the threaded portion of the AN490. For such installations, a 5/16 in thread is recommended instead of the usual ¼ in thread. The clevis bolt may remain ¼ in in dia. for it is subjected to single shear on the body of the bolt (at the full ¼ in of dia.) and is usually made of alloy steel. The AN490 is of 1025 steel and is subjected to bending and shear at the root section of a "v" thread, at a cross-sectional area almost 30% less than that of the ¼ in bolt. Shear nuts should always be used with clevis bolts, and castellated nuts with hex-head bolts, because the cotter pin holes in the bolts are drilled to align with the respectively mentioned nuts when the nut is turned down to the shank length indicated by the dash number of the bolt.

CONSERVATION OF AIRCRAFT MATERIALS

(*Continued from page* 249)

lurgical or other technical assistance when needed and requested in the development of new processes.

5. Issue information and recommendations to industry with regard to new methods that have been demonstrated to be sound from engineering and production standpoints.

The functions of the respective field organizations of the AAF and Navy Bureau are to:

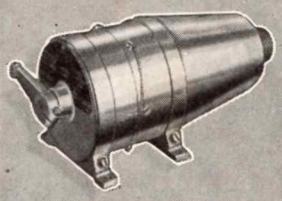
1. Disseminate to AAF contractors information and recommendations on improved processes.
2. Cooperate with and assist AAF contractors in the development of new material processing methods.
3. Encourage and promote the introduction of proven new techniques and processes wherever savings in critical materials and manpower can in any way be effected.
4. Serve as intermediaries between the contractor and cognizant divisions, branches and sections of the AAF on engineering and production questions regarding materials and facilities which may arise in the development or introduction of new processes.
5. Submit reports in such detail as may be required on new manufacturing processes.
6. Facilitate exchange of information on conservation methods between contractors within assigned territory.
7. Cooperate in detail with the field representatives of the Navy Bureau of Aeronautics.

The Operating Committee on Aircraft Materials Conservation will:

1. Coordinate action taken by the AAF and the Navy Bureau in encouraging more efficient and economical manufacturing processes.
2. Cooperate with trade associations, special research groups of the aircraft and other industries, the War Production Board (through the Aircraft Resources Control Office) and other military and civil branches of the Federal government in the development and introduction of new material processing methods.
3. Facilitate the exchange of information on improved processes between the United States and its allied nations.
4. Release information on improved methods through special reports and trade publications.

Every effort has been made to avoid conflict and duplication of effort between the field activities of the two Air Services so as to facilitate and expedite action on contractors' problems.

BARBER-COLMAN CABIN TEMPERATURE CONTROL SYSTEMS



THE usual arrangement employs a Control Motor on a butterfly valve in the outlet of a heater unit. The position of this valve is controlled from a Thermostat which automatically proportions the heat supply to maintain uniform cabin temperature. A Duplex Thermostat is available when simultaneous control of parallel systems is desired. If the airplane has intercoolers and aftercoolers, heat from these may also be valved to the cabin by Control Motors. A Limit Thermostat in the duct is often used to prevent excessive temperature in the heat distribution system. Barber-Colman Cabin Temperature Control Systems are adaptable to all types of bombers, transport, cargo and commerical passenger aircraft and have successfully demonstrated accurate and reliable service at any altitude. Write for detailed information.

BARBER-COLMAN COMPANY, ROCKFORD, ILLINOIS

On Lockheed Lightning Resistoflex instrument lines are impervious to aromatics

Photo, Courtesy Lockheed Aircraft Corporation

WHEN a Lightning starts on its important mission, its Resistoflex instrument lines are free from any possibility of gumming or internal erosion . . . thanks to their inner surface of COMPAR. This is the unique elastic plastic capable of so many variations that each is literally tailored to the job.

Used in Resistoflex aircraft hose assemblies, COMPAR is impervious to oils, hydraulic fluids, gasoline and fuel blends . . . even those having the highest aromatic content. The COMPAR surface is glass-smooth too, keeping turbulence and skin friction down to a minimum.

Resistoflex aircraft hose is built for maximum strength, toughness and flexibility. It is ounces lighter than other hose of similar construction, yet far stronger. It withstands heavy shock loads, is unaffected by flexing and vibration.

Resistoflex hose assemblies are supplied in all standard dimensions and lengths for instrument and medium pressure hydraulic lines in conformity with applicable Army and Navy specifications. For full details, write for the Resistoflex Aircraft Catalog.

OIL-IMMUNE MOLDED PARTS

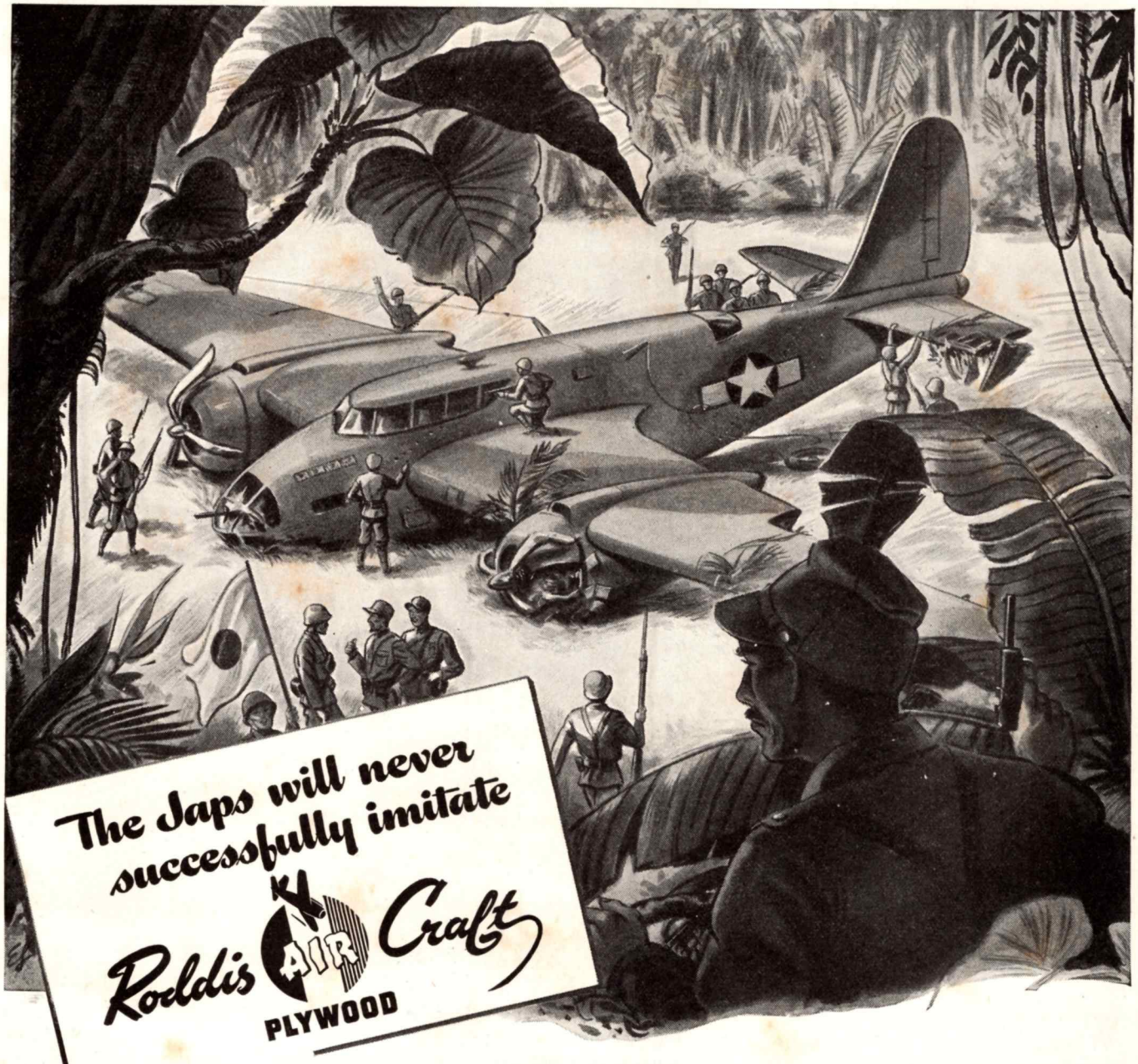
Gaskets, diaphragms and many other molded parts are also produced from COMPAR—the *same* elastic plastic that gives Resistoflex hose its unique properties. Parts can be made entirely from COMPAR, or from sheets with fabric or metal inserts.

Many COMPAR formulations are available. They are indicated for applications requiring complete imperviousness to oils, gasoline and fuel blends, as well as other organic solvents and many gases . . . plus high strength and abrasion resistance. Write for further information.

RESISTOFLEX

LOW AND MEDIUM PRESSURE INSTRUMENT, HYDRAULIC AND VACUUM HOSE ASSEMBLIES — MANOMETER TUBING, DIPPED AND MOLDED SPECIALTIES.

RESISTOFLEX CORPORATION, BELLEVILLE, NEW JERSEY



If a plane or glider constructed of Roddis aircraft plywood should fall into the hands of enemy imitators, they'll get scant comfort from it. The closest examination won't impart the skill and craftsmanship that went into its production.

Tests will prove the rugged strength of Roddis aircraft plywood. Dissection will reveal the perfect bonding—show that moisture, heat, pressure, time, and bonding agent all have been exactly and skillfully applied and controlled.

But it takes more than a knowledge of the physical factors of production to create Roddis aircraft plywood — it takes craftsmanship, skill, knowledge of wood — extra "know how" which has identified Roddis wood products for over 50 years—and which today is reflected in uniformity of quality that sets the pace for the aircraft plywood industry.

Plane and glider manufacturers are invited to consult with Roddis men located at our warehouses shown below.

RODDIS LUMBER AND VENEER COMPANY
Marshfield, Wisconsin

RODDIS COMPANY
1435 W. 37th St., Chicago 9, Ill.

RODDIS LUMBER AND VENEER COMPANY
4601 W. State St., Milwaukee 8, Wis.

RODDIS LUMBER AND VENEER CO. OF MISSOURI
2729 Southwest Blvd., Kansas City 8, Mo.

RODDIS PLYWOOD AND DOOR COMPANY, INC.
15 Carleton St., Cambridge 42, Mass.

RODDIS PLYWOOD AND DOOR COMPANY, INC.
515 W. 36th St., New York City 18, N. Y.

RODDIS LUMBER AND VENEER CO. OF MISSOURI
2615 Latimer Street, Dallas, Texas

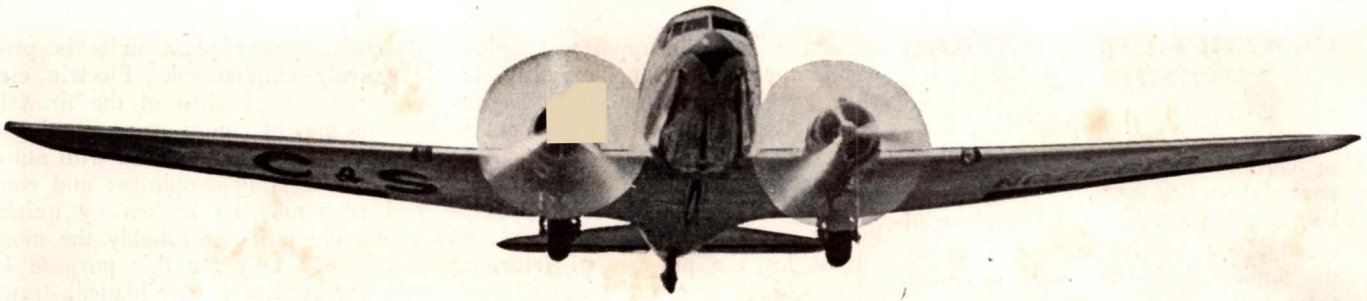
RODDIS LUMBER AND VENEER CO. OF MISSOURI
727 N. Cherry St., San Antonio, Texas

RODDIS PLYWOOD AND DOOR COMPANY, INC.
Review and Greenpoint Avenues
Long Island City, New York

RODDIS PANEL AND DOOR COMPANY
457 E. Sixth St., Cincinnati, Ohio

RODDIS PANEL AND DOOR COMPANY
1204 W. Ormsby Ave., Louisville, Ky.

RODDIS LUMBER & VENEER CO.
MARSHFIELD, WISCONSIN



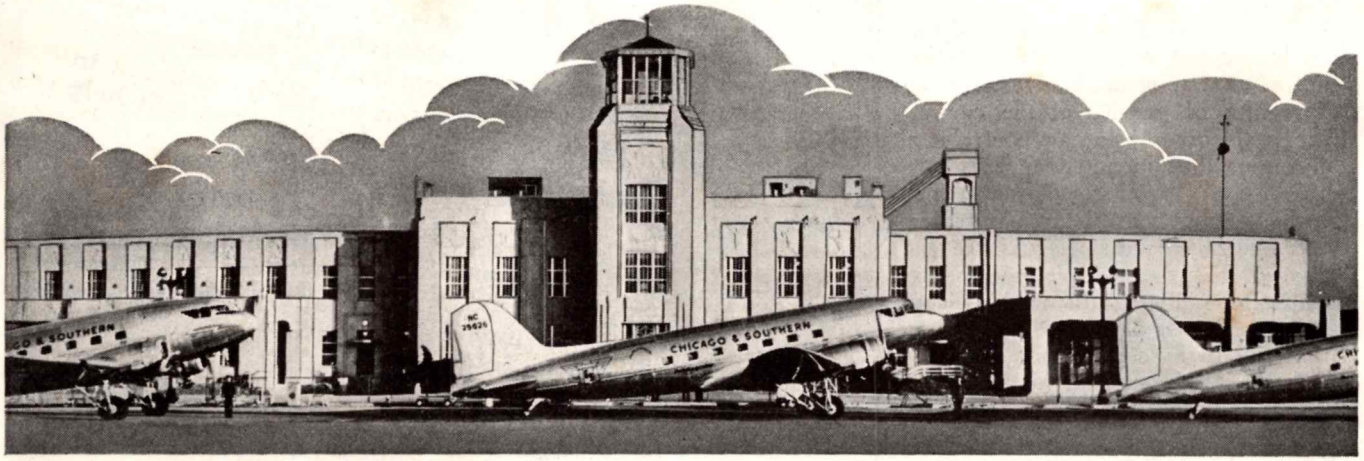
Winged Millions

In 1933 a newcomer — Chicago and Southern Air Lines — entered the transportation field.

Now, as a major company celebrating its tenth anniversary, it can proudly measure a decade's service in terms of millions:

14,441,747 revenue miles flown —
684,951,988 pound miles of express flown —
1,980,646,795 pound miles of mail flown.

In this air transportation achievement *correct* lubrication had a part. Chicago and Southern uses Sinclair Pennsylvania Motor Oil exclusively for safe lubrication of its modern fleet of Douglas Dixieliners.



SINCLAIR AVIATION OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY (INC.), 630 FIFTH AVENUE, NEW YORK 20, N. Y.

POWERPLANT CONTROL SYSTEMS

(*Continued from page* 451)

or vertical movement combined with its axial motion. A conical sleeve or boot of asbestos or other fabric clamped around the control and fastened to the bulkhead is employed in most cases, although fiber blocks sliding in a retaining plate have been used for this purpose. Boots are not practical for torque tubes which rotate more than approximately 180°.

"Flexible controls," so called, consist of a fixed tubular outer casing of solid tube or coiled wire, with or without fabric covering and a sliding inner member which may be a plain solid wire, a wire-wrapped cable, or a series of segments strung on a cable. The minimum bend limits of the various types of casings and sliding members vary from 1½ to 6 in inside radius. Such small bends tend to increase the force necessary to move the control; therefore, few should be used, and these should be of as generous a radius as is possible. In controls which employ lubricants between casing and sliding member, that control force will increase with a drop in external temperature because of the lowered viscosity of the lubricant.

Controls to Elastic Mounted Engines

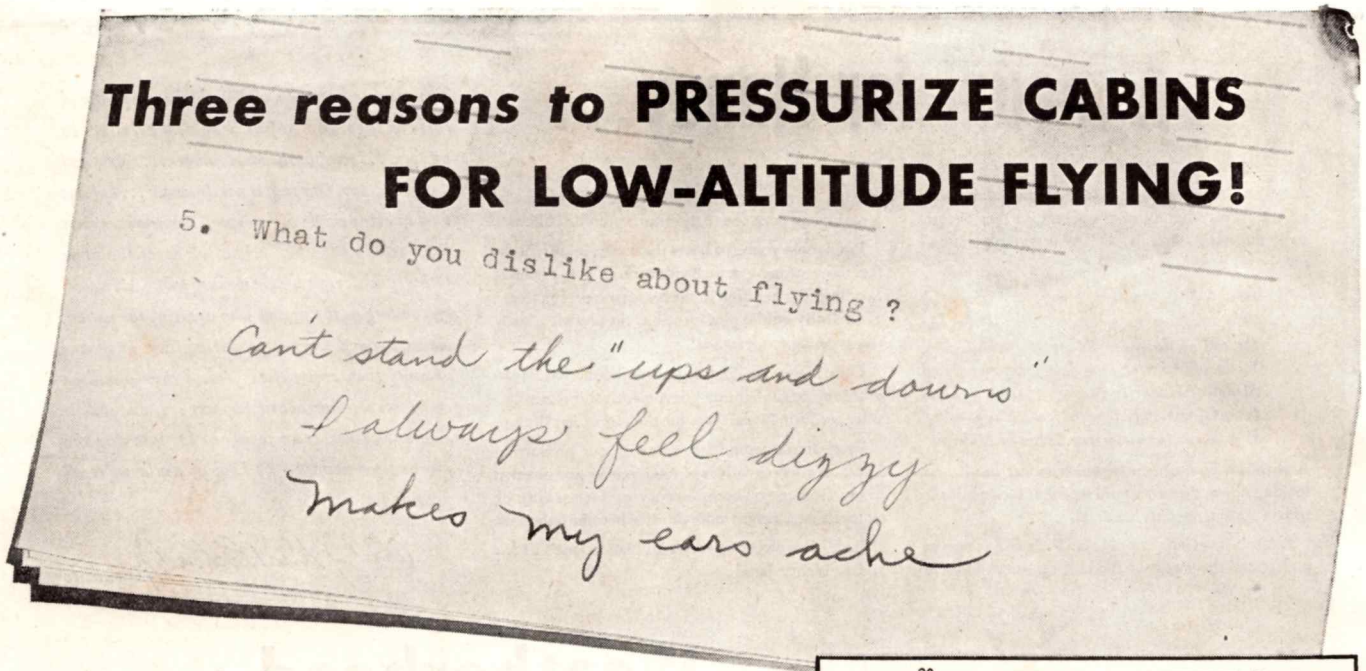
An engine or an elastic mounting will have a great deal of freedom of motion relative to the aircraft structure. As an example a typical large aircooled radial engine will have, at the rocker box covers, almost 1 in of motion in wind-up (circumferentially), ¼ in fore-and-aft, and better than ½ in radially. The axis of the circumferential motion is the centerline of thrust, somewhat forward of the center of gravity of the engine. The problem of bringing controls to an engine thus mounted appears formidable at the outset; however, the various engine controls are located in from the outside diameter of the engine so that their displacements are relatively less than at the outside diameter. By proper placement of the firewall end of the control run, use may be made of the self-aligning properties of ball bearing rod ends or of the parallel linkage character of a closed cable system to absorb, within the control run, any relative displacement of the terminals of the run. In extreme cases it is sometimes necessary to resort to telescoping keyed or square jackshafts to absorb some of the motion. Flexible controls may be employed where control loads are so light as to obviate the possibility of deflection in the unsupported length of casing necessary for flexibility between engine and firewall or engine-mount. Spring devices should not be included in the control run circuit as this is tantamount to introducing built-in backlash to the system. Springs may be used externally to a closed circuit for the purpose of returning a control to a given position when the handle is released, or to provide a progressively heavier feel to a control, or to hold a control against a stop.

The quick-detachable mechanism for control runs is coming more into use, as speed in removal and replacement of entire power plant units is progressively emphasized. Electric circuits may be broken at the firewall by means of multi-pronged plugs; plumbing may be provided with automatically sealing couplings; and control runs may be broken by quick-detachable units. Probably the most satisfactory unit for this purpose is manufactured as a four bladed, draw-in collet with a spring-loaded external sleeve to provide the holding force on the jaws. This unit replaces the usual AN490 rod end, and is applicable to flexible control runs.

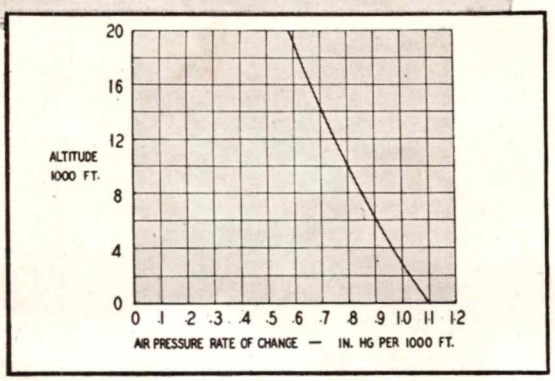
Rod ends of the AN490 type have

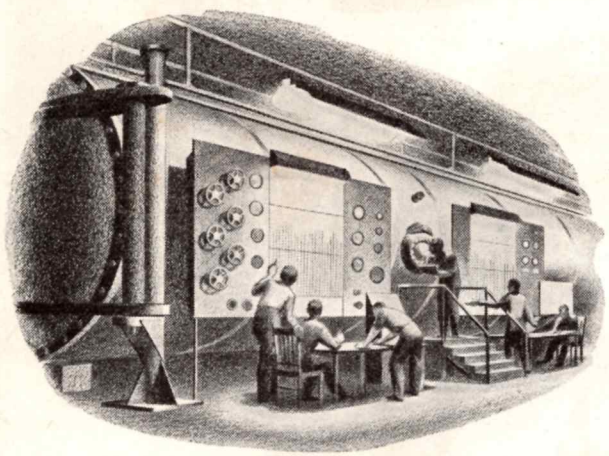
(*Continued on page* 463)

Three reasons to PRESSURIZE CABINS FOR LOW-ALTITUDE FLYING!



A RECENT SURVEY reveals the most common passenger objections to air travel are the *discomforts caused by changing air pressures.* And as chart here shows, pressure changes are most severe at the comparatively low altitudes through which most airlines operate . . . and are greatest during the airliner's climb and descent.





IN OUR "STRATOLAB," AiResearch engineers have been perfecting controls to *hold pressure constant* during climbs and descents . . . to *adjust pressure* gradually during airliner flight from low to higher altitude airports.

AiResearch Cabin Pressure Regulating Systems will be able to hold *sea level* altitude inside airliners flying as high as 20,000 feet!

From this AiResearch engineering will come pressurized cabins for postwar airliners–"living room" comfort for passengers at all times . . . and increased travel business for the airlines.

Information is available now to U. S. aircraft manufacturers and airline operators.

AiResearch
MANUFACTURING COMPANY
LOS ANGELES • PHOENIX
DIVISION OF THE GARRETT CORPORATION

"Where Controlled Air Does the Job" • Automatic Exit Flap Control Systems • Engine Oil Cooling Systems • Engine Air Intercooling Systems • Exhaust Heat Exchangers • Supercharger Aftercooling Systems • Engine Coolant Systems

A medal for Nancy...

LITTLE Nancy Jane is only six. She stood alone, with all the inborn dignity of childhood, in that historic room amid the admirals, the senators, the great and near-great grown-ups.

She heard a deep, resonant voice say:

"For conspicuous gallantry over and beyond the call of duty, the Congress of the United States of America awards the Congressional Medal of Honor to Marvin Clayton — Lieutenant-Commander, United States Navy—killed in action at the victorious Battle of Midway."

And then a blue ribbon passed over her head. And looking down, she saw a gold medal at the end of the ribbon nestling against her dress.

Little Nancy Jane is only six. She's too young to understand the words of the citation—not quite old enough to realize that this blue-ribboned gold medal is the highest honor our nation can bestow on its heroes.

But not too young to know that never-more will she feel those strong, gentle hands tucking in her blanket ...or hoisting her high in the air for a morning kiss... or patiently guiding her pencil as she scrawls a birthday greeting to Grandma!

Little Nancy Jane is only six—and fatherless! However long actual fighting goes on—this war means sacrifice for little Nancy Jane for the rest of her life!

Every single second lost today on our production lines...every hoarded bit of food, rubber and metal... every moment of complacency or face-saving or temporizing...means more children become fatherless.

Each of us owes something to Nancy Jane's dad... and to Nancy Jane!

The men and women of Weatherhead sponsored this message. Most of us have near relatives in uniform ... sons, husbands, brothers ... sisters and daughters, too. Our task is not dramatic ... but it is vital to every single big weapon. For years we have been making for peacetime purposes the same fittings and devices we are making today. However, responding to the urgent war needs of the nation, we have found ways of producing them in greater quantity than ever before — more than a million every twenty-four hours! So, you see, our skill is also one of the great weapons for winning the war and for building the kind of world we're all fighting for.

Albert J. Weatherhead, Jr. PRESIDENT

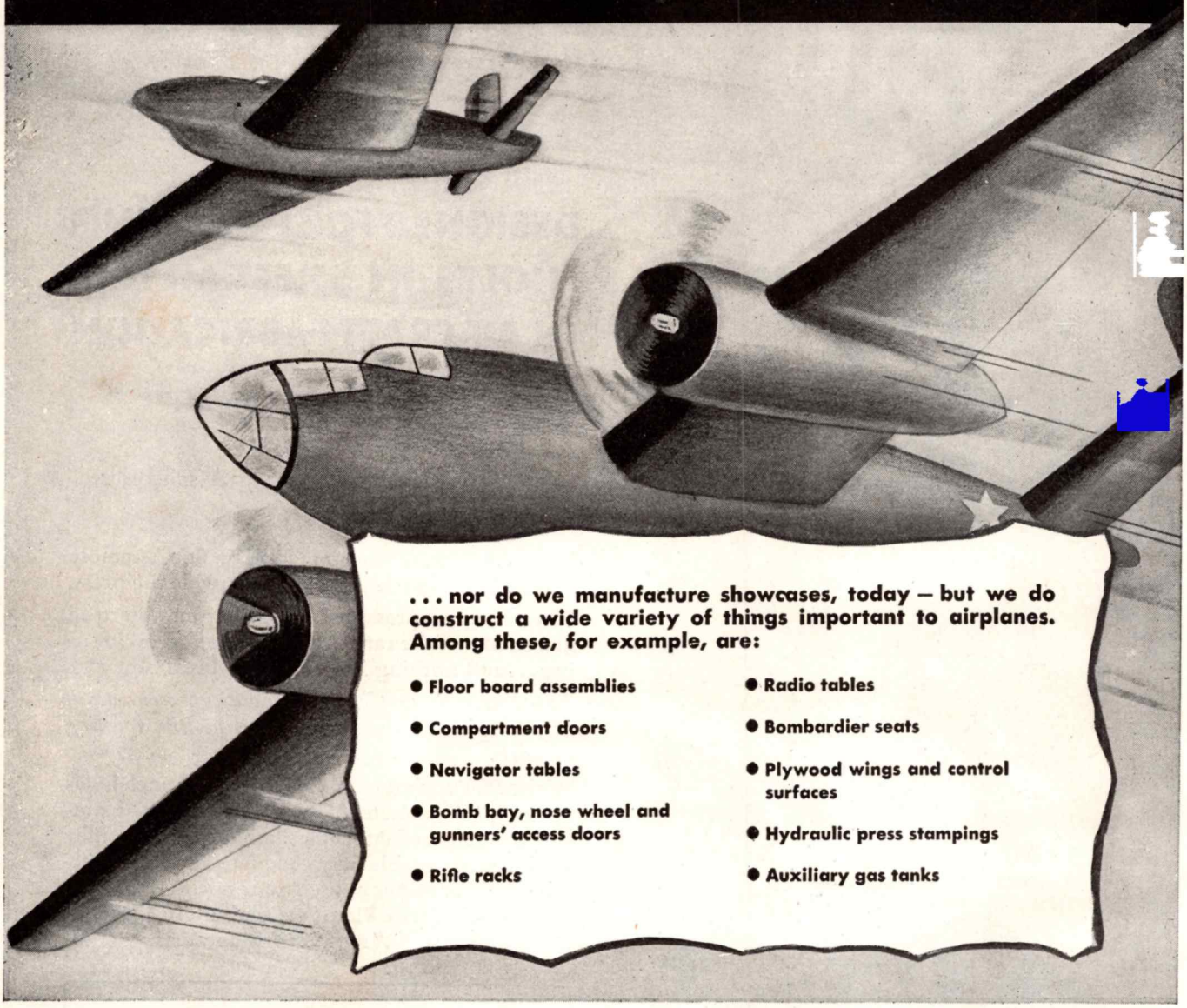
Weatherhead

THE WEATHERHEAD COMPANY • CLEVELAND, OHIO

Headquarters for fittings, hose assemblies, hydraulic devices and essential machine parts

Plants: CLEVELAND; COLUMBIA CITY, IND.; LOS ANGELES; ST. THOMAS, ONT.

WARPLANES DON'T CARRY SHOWCASES, of Course . . .



. . . nor do we manufacture showcases, today – but we do construct a wide variety of things important to airplanes. Among these, for example, are:

- Floor board assemblies
- Compartment doors
- Navigator tables
- Bomb bay, nose wheel and gunners' access doors
- Rifle racks
- Radio tables
- Bombardier seats
- Plywood wings and control surfaces
- Hydraulic press stampings
- Auxiliary gas tanks

ONE OR MORE of these items is flying on many a U. S. headline-making airplane—fighters, bombers, cargoes and transports. The Aircraft Division at Weber is a flexible organization set up to meet efficiently the varied production demands of the plane manufacturers it serves. It is well equipped in facilities and experience to solve many special manufacturing problems in metal, wood or glass. Our engineers are here to serve you—write or wire today for their solutions to your specific problems.

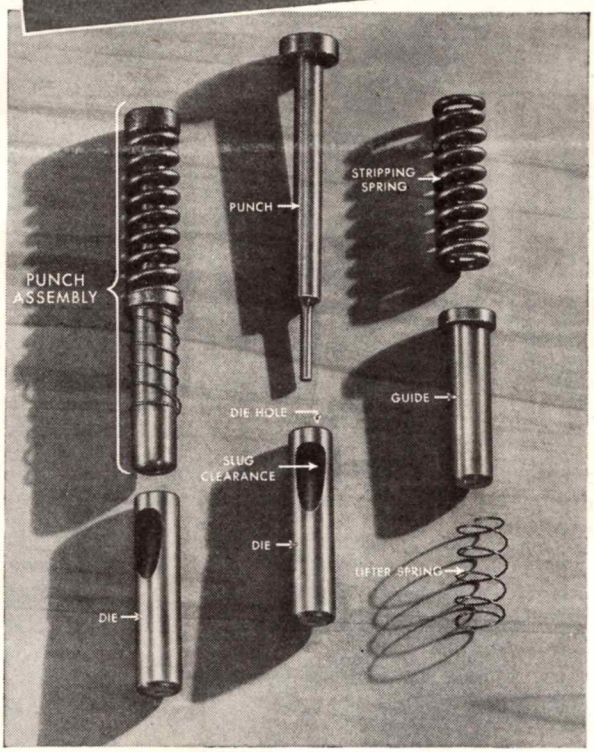
WEBER FACILITIES & EXPERIENCE "WORKING FOR VICTORY"

ARMY E NAVY

AIRCRAFT DIVISION

WEBER SHOWCASE & FIXTURE CO. INC., 5700 AVALON BLVD., LOS ANGELES, CALIF. • EST. 1898

WALES *Plate Set System*



Wales PS Punch Assemblies and Dies showing parts assembled and disassembled.

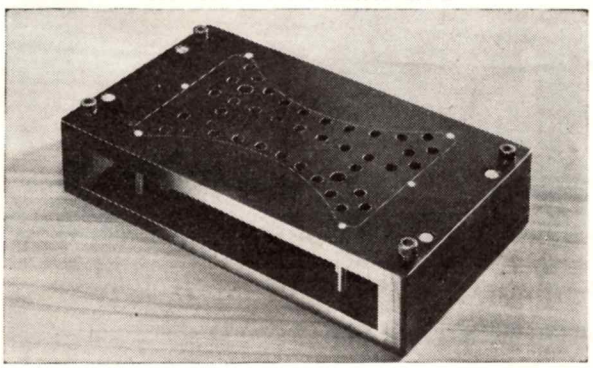
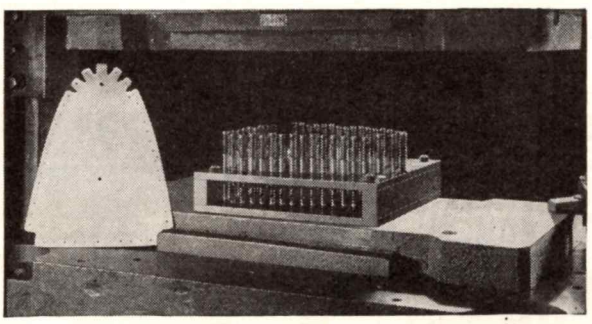


Plate Set with pattern holes.



Complete Plate Set Assembly ready to be placed on press bed.

DESIGNED FOR PUNCHING HOLES IN SHEET METAL IN AIRCRAFT FABRICATION

This System is made up of:

1. Walesite Plate Sets.
2. Wales PS Punching Assemblies and Dies.

The complete, self-contained Plate Set Assembly may be made quickly and easily outside the press.

Placed on the press bed, punching may start on first stroke of the ram... no adjusting... no locating... and nothing is attached to press ram.

This System is simple, fast, convenient, economical, easy to operate, no scratching and positive locating of parts.

Wales PS Punch Assemblies and Dies punch holes up to 5/16″ diameters. By standardizing on outside diameters of Punch Assemblies and Dies they are interchangeable between plate sets which permits their continuous use and re-use in unlimited patterns. Walesite Plate Sets are built in 36 standard sizes up to 42″ x 45″ working areas.

2 CHOICES

1. Template may be sent to us for quotation of complete die ready to operate. We recommend this procedure.

2. To the user who desires to build the dies, we will supply Plate Sets, Punch Assemblies and Dies with complete drilling and assembling instructions.

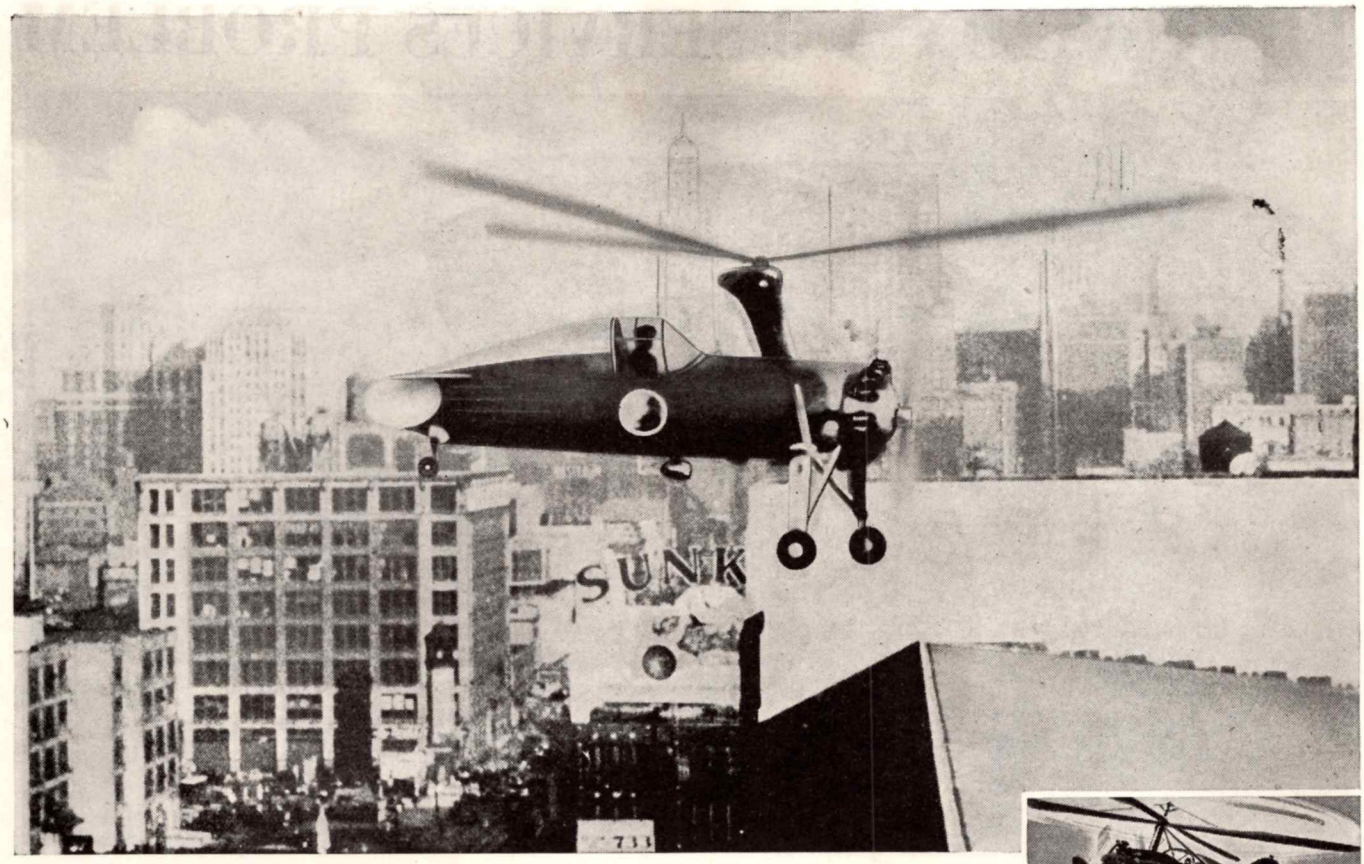
Write for Catalog PS.

WALES-STRIPPIT CORPORATION

347 Payne Avenue No. Tonawanda, N. Y.

GEORGE F. WALES, President

Specialists in Punching and Notching Equipment



The Eastern Air Lines KELLETT which flew mail for a full year from the roof of the Philadelphia Post Office. One of many Kellett "firsts" in its years of pioneering the manufacture of rotary wing aircraft.

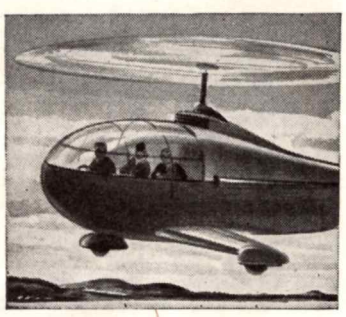
THE PIONEER LOOKS TO TOMORROW

A Kellett accompanied Admiral Byrd on his voyage to the South Pole.

TODAY in cooperation with the U.S.A.A.F. Kellett is speeding the engineering development and production of autogiros and helicopters for military needs. We cannot give details now. Five Kellett plants are also applying their aeronautical ingenuity to the production of important parts for some of America's most famous fighters and bombers — Thunderbolts, Liberators, Warhawks and Marauders . . . while an expanding corps of forward-looking engineers continues Kellett's rotary wing developments for the future.

TOMORROW we look forward to opportunities for Kelletts to cut time and costs in patrolling electric power lines, oil pipe lines, in transporting mail and passengers, dusting crops—and in a wide variety of services for industry, commerce, forestry and agriculture. Kellett's years of experience and accomplishments continue to attract pioneering minds, men who, with us, see vast opportunities for rotary wing progress in the post-war era. Kellett Aircraft Corporation, Upper Darby (Philadelphia), Pennsylvania.

Border-patrol use is dramatically demonstrating Kellett serviceability.

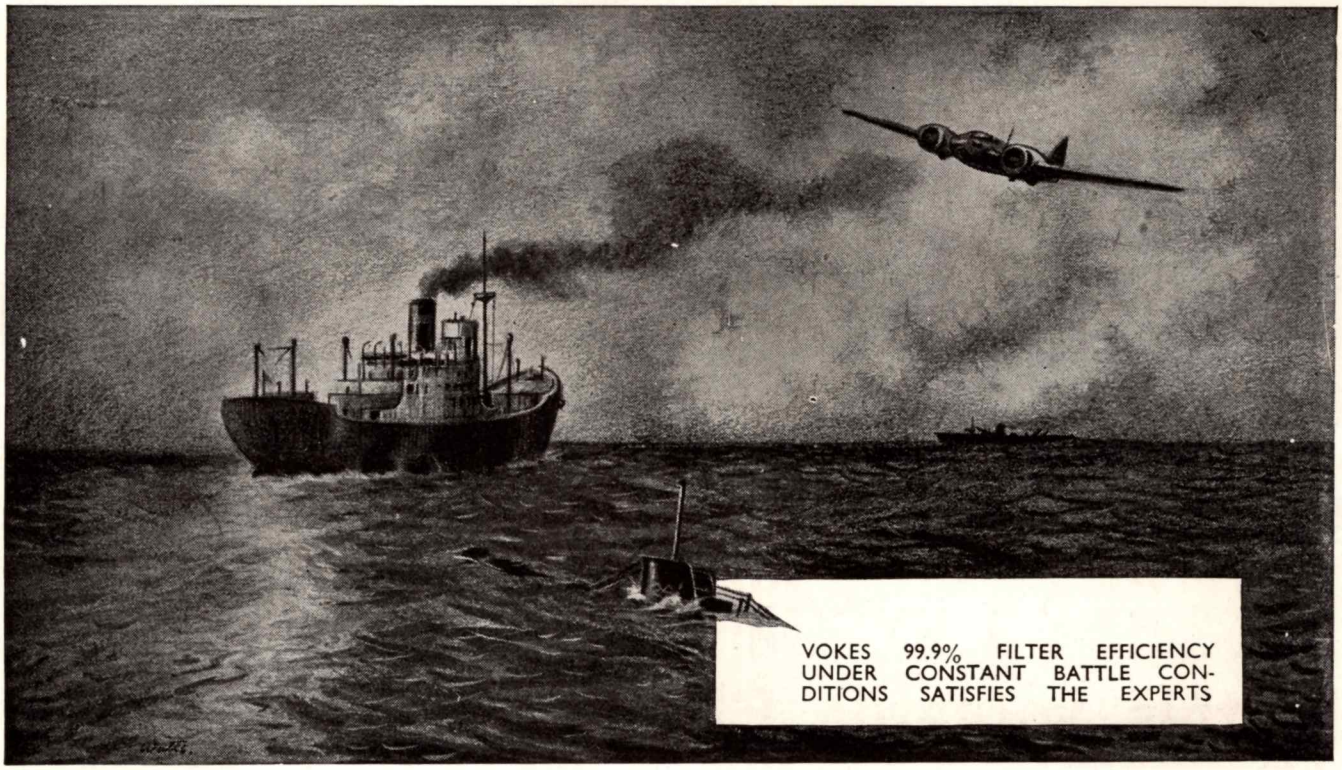


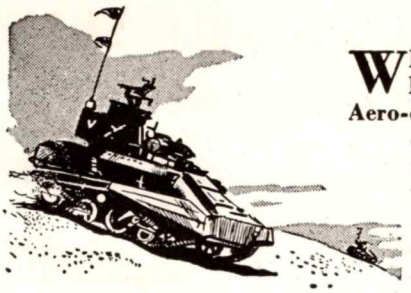
. . . and Kellett is looking to a future of expanding service to the nation

K E L L E T T

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY

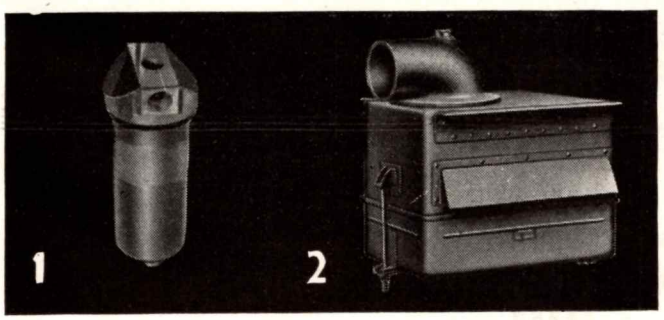
FILTRATION A 3 SERVICES PROBLEM

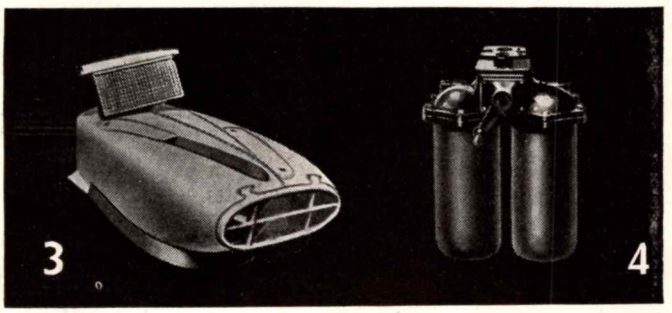




WE hear a lot of " talk " about man power naturally, because it concerns the people. But the engineer experts of the services have their own special problem, engine power. Aero-engines in their thousands, the mighty engines for submarines, auxiliary motor craft and mechanised units of the Army, each and every one has to be kept " fighting fit." That is why the filtration of air, oil and fuel oil to these engines is of such vital importance, because on purity of air, oil and fuel oil for engines depend power and speed. Our organisation is working to capacity to provide Vokes Air, Oil and Fuel Oil Filters to all branches of the services. H.M. and Dominion Governments approve and adopt Vokes Filters. Their 99.9 per cent. standard of filtration efficiency is unvarying, and has been tried and tested out under actual fighting conditions. Like everything connected with the fighting forces, Vokes Filters don't half do the job, but do it thoroughly.

1. Vokes High Pressure Oil Filters for Aircraft. 2. Vokes Tank Oil Bath Air Cleaner. 3. Vokes Air Filter for Aero-Engines. 4. Vokes Twin Oil Filters for Diesel Engines.





VOKES

VOKES LIMITED · FILTRATION EXPERTS

THE ARTHUR S. LEITCH CO. LTD., 1123 BAY STREET, TORONTO, CANADA
E. CANTIN, 101 PARK AVE., NEW YORK

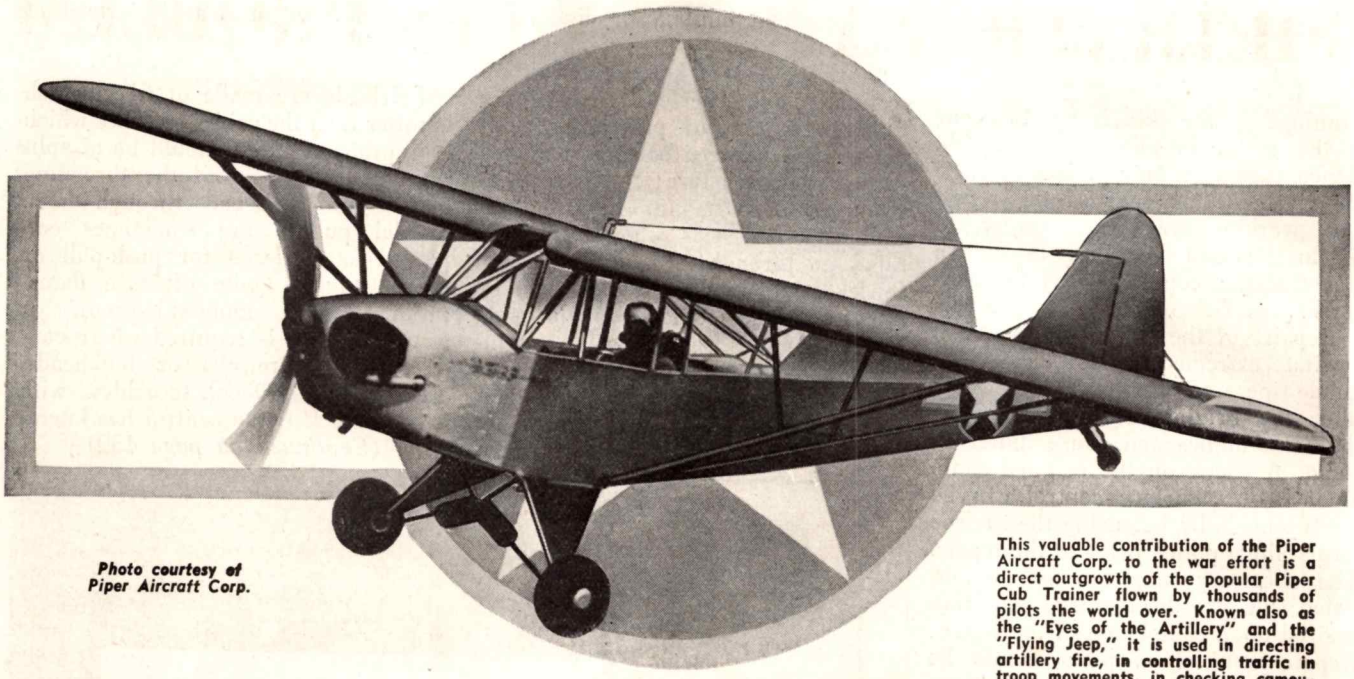
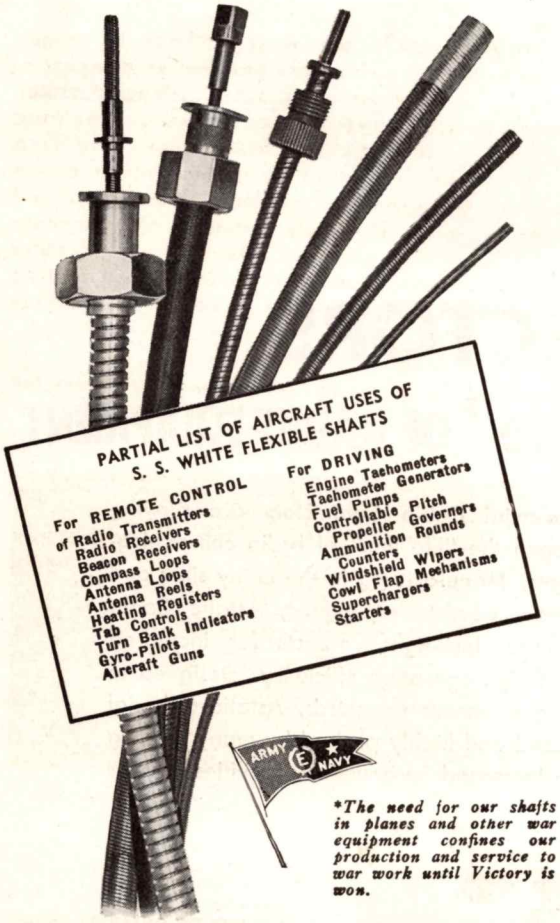


Photo courtesy of Piper Aircraft Corp.

This valuable contribution of the Piper Aircraft Corp. to the war effort is a direct outgrowth of the popular Piper Cub Trainer flown by thousands of pilots the world over. Known also as the "Eyes of the Artillery" and the "Flying Jeep," it is used in directing artillery fire, in controlling traffic in troop movements, in checking camouflage, in carrying messages and in many other behind-the-line observation and liaison duties.

In this versatile PIPER *"GRASSHOPPER"*



PARTIAL LIST OF AIRCRAFT USES OF S. S. WHITE FLEXIBLE SHAFTS

For REMOTE CONTROL of
Radio Transmitters
Radio Receivers
Beacon Receivers
Compass Loops
Antenna Loops
Antenna Reels
Heating Registers
Tab Controls
Turn Bank Indicators
Gyro-Pilots
Aircraft Guns

For DRIVING
Engine Tachometers
Tachometer Generators
Fuel Pumps
Controllable Pitch Propeller Governors
Ammunition Rounds Counters
Windshield Wipers
Cowl Flap Mechanisms
Superchargers
Starters

an S. S. WHITE FLEXIBLE SHAFT drives the engine tachometer . . .

And you will find S. S. White Flexible Shafts performing this responsible job in a great many other U. S. Army and Navy aircraft. It is one of numerous uses of S. S. White Flexible Shafts in warplanes. The partial list at the left gives a fair picture of the extent and importance of these applications.

That S. S. White is bending every effort to meet all demands for flexible shafts and accessories, is evidenced by the Army-Navy "E" with its recently added star. To all manufacturers who need shafts for war work or have shaft problems S. S. White offers all possible cooperation.*

DATA FOR ENGINEERS — The following bulletins will be mailed on request to interested aircraft engineers.
BULLETIN 1238 — Flexible Shafts for Power Drives.
BULLETIN 38-42 — Flexible Shafts for Remote Controls.
BULLETIN 43 — End Fittings for Flexible Shafts.

**The need for our shafts in planes and other war equipment confines our production and service to war work until Victory is won.*

S. S. WHITE

The S. S. White Dental Mfg. Co.

INDUSTRIAL DIVISION

Dept. F. 10 East 40th Street, New York 16, N. Y.

FLEXIBLE SHAFTS • AIRCRAFT ACCESSORIES • MOLDED PLASTICS PRODUCTS

REPAIR OF METAL AIRCRAFT

(*Continued from page* 258)

canning" of the skin is apt to occur if the metal is allowed to stretch. Hence, care must be exercised to place the rivets at the ends of the repair and, working toward the center, to fill in the scattered rivets in such a way that this condition may be overcome.

Repairs of the control surfaces necessitate extreme care, for any appreciable increase of weight here may alter the original static balance of these assemblies and cause flutter in flight. A check on the original static balance of a surface control can be readily made by balancing the surface on its hinge points prior to the repair. The necessary moments and weight noted will give the required condition desired upon completion of the repair. Repair material or parts should be weighed and the necessary calculations made so that weight can be added to the nose section, thus balancing the surface control and maintaining its original design static balance. The amount of weight being added is predetermined and the surface must actually be weighed and balanced before it is installed on the airplane.

Current design of surface controls allows for this condition by providing removable weights at the nose section. These weights can be readily removed and the necessary weight added to balance the surface. However, wherever weights are built in the nose structure, lead plates can be distributed properly at the nose section and attached by means of blind rivets or lock screws. If the repair is extensive and the correct balance cannot be arrived at, the surface should be replaced.

POWERPLANT CONTROL SYSTEMS

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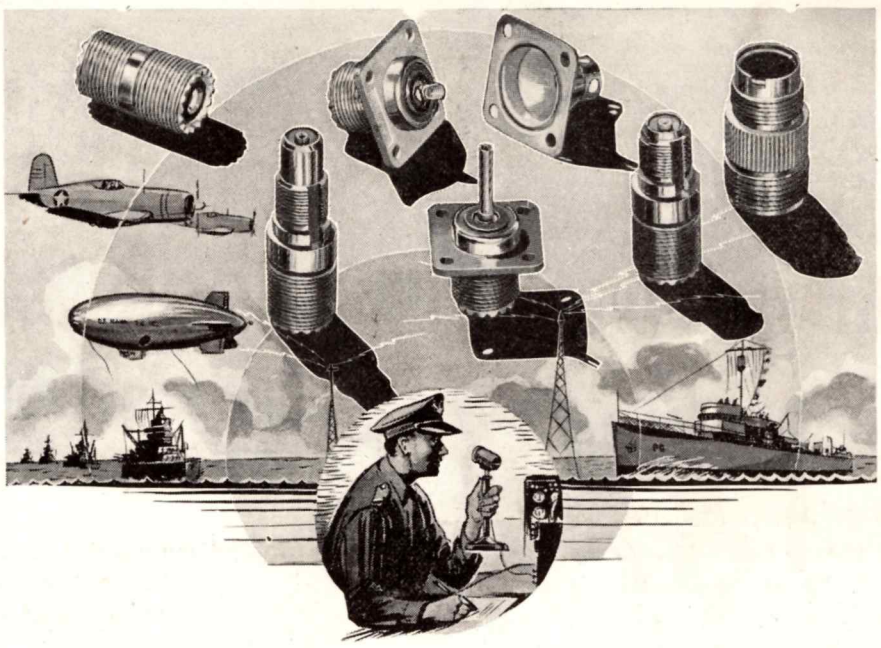
sembly in order to thread a cable. Pulley brackets should be of rigid construction so that they will not deflect under rigging and operating loads. Swaged fittings for cable ends are indicated for they obviate the stretch inherent in splices and thimbles. Fig. 2 shows a table of average lengths of the standard Navy splices for various cable diameters. Shortening these splices by using less than the requisite number of tucks is not advisable. An inch at least should be allowed between the end of a splice and point of contact with the pulley. Adjustment of cable lengths for rigging is provided for by inserting a turnbuckle in every cable run and these should be safe-tied in accordance with pertinent military or civil regulations.

Fairleads should not be used as direction changing devices. Their proper function is that of preventing chafing contact between control runs and surrounding structure; to act as antivibration supports for long control runs; and as seals where cables or tubes go through a bulkhead. Cable fairleads should not be a close fit or even in constant contact with the cable because of the friction and wear involved. Application of lubrication at the fairlead may do more harm than good, as the lubricant may pick up grit and dirt and act as a cutting compound. A lubricated fairlead at a firewall is poor practice because of the inflammability of the lubricant.

Fairleads are made of fiber which is softer than the cables or tubes which they protect. They should be of split construction to permit the threading of rod and cable ends through them. Special pulleys are sometimes employed as fairleads for push-pull or torque tubes. Quite often, a flameproof, carbon monoxide-proof, or watertight seal is required where controls pierce firewalls or bulkheads. Such a seal is difficult to achieve with a fiber block if the control has lateral

(*Continued on page* 459)



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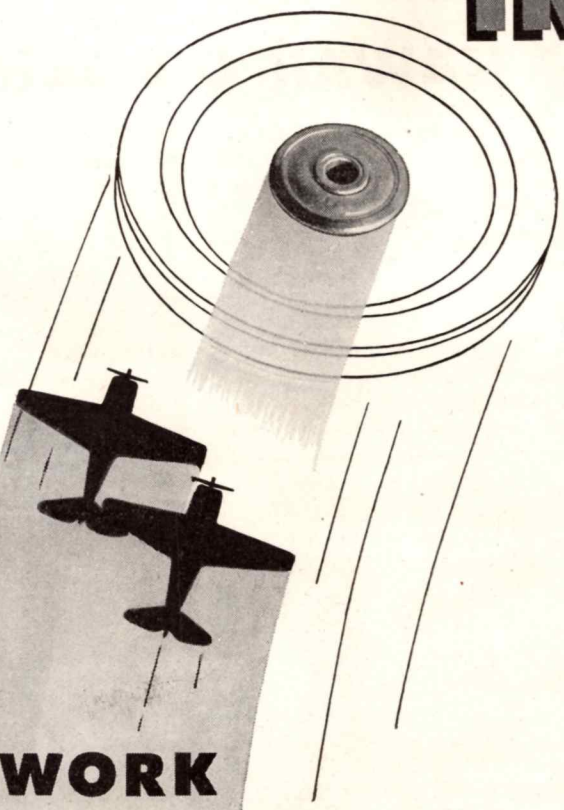

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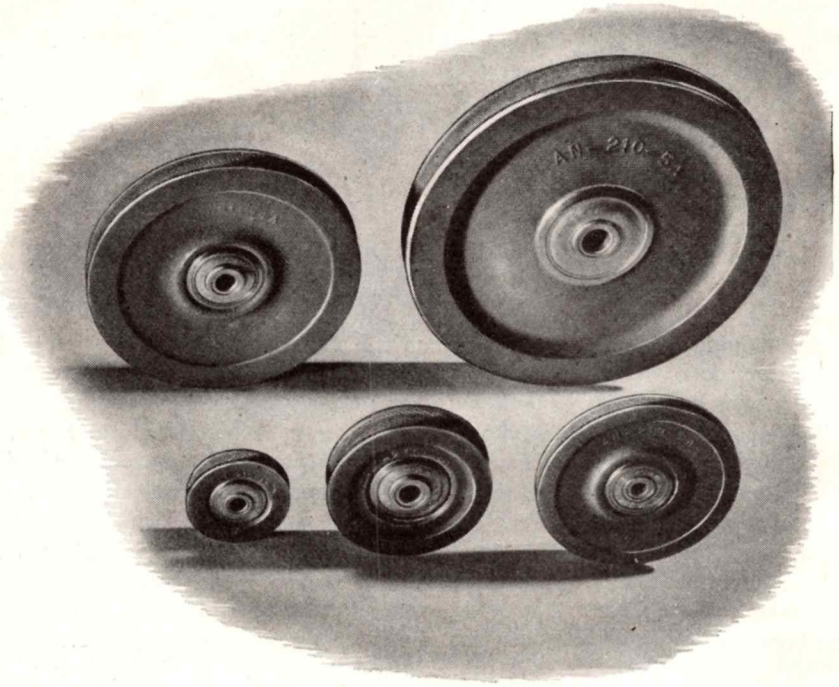

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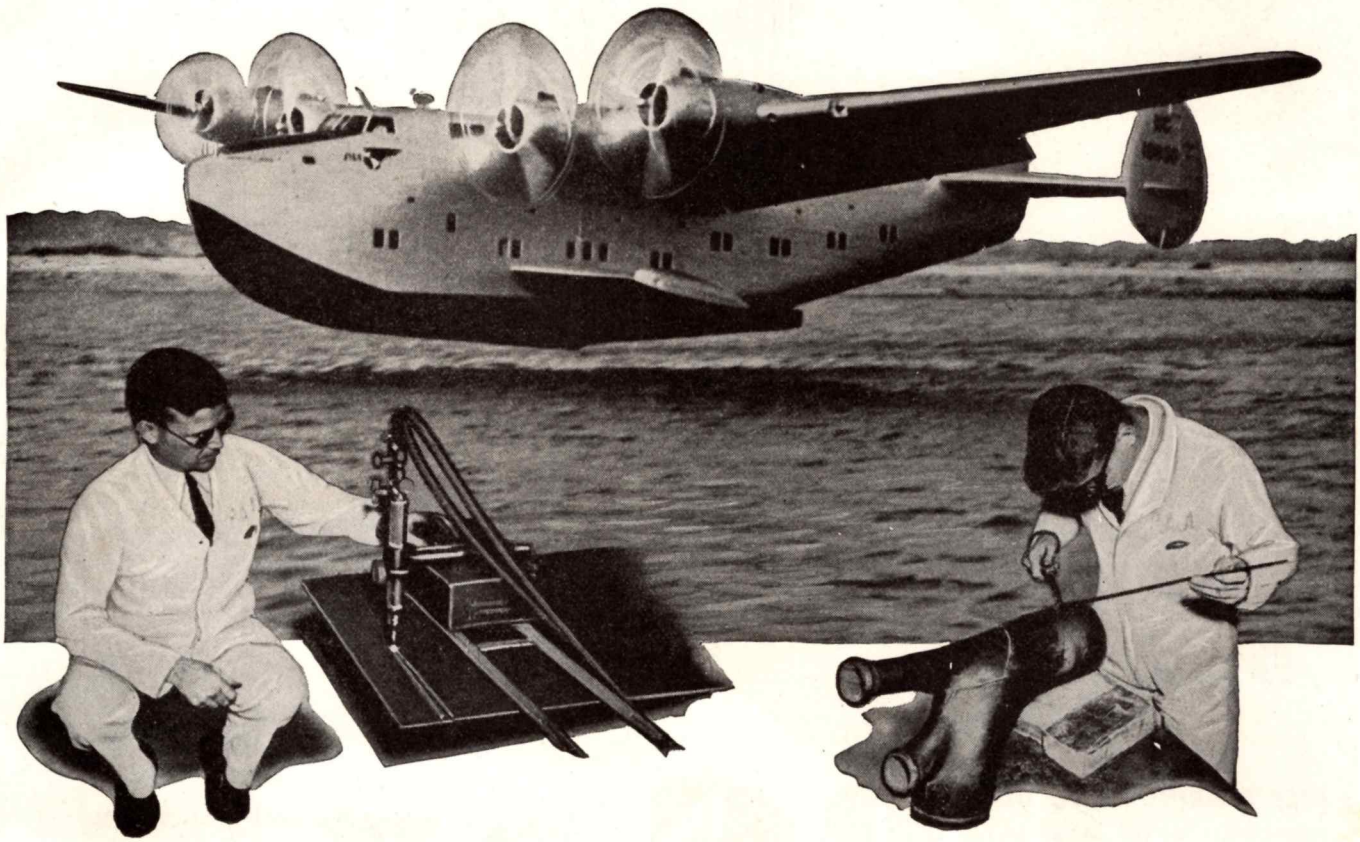

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